

Remedial Investigation/Feasibility Study Field Sampling Plan

Ogallala Groundwater Contamination Site OU1

Ogallala, Nebraska

April 5, 2019

EPA Contract No.: EP-S7-05-06 EPA Task Order No.: 68HE0719F0016 BVSPC Project No.: 44818



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1.0 Introduction

The U.S. Environmental Protection Agency (EPA) has initiated Remedial Investigation/ Feasibility Study (RI/FS) efforts for the Ogallala Groundwater Contamination Operable Unit 1 (OU1) site (Site) in Ogallala, Nebraska. The RI/FS is part of the methodology that the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program has established for investigating and mitigating risks posed by uncontrolled hazardous waste sites. Performance of the RI/FS efforts is as described in this *FSP*, the *Health and Safety Plan* (HSP) (BVSPC *in preparation*), and the *Quality Assurance Project Plan* (QAPP) (RTI 2018).

This FSP presents a detailed description of activities planned for RI/FS activities at the site. It includes the following items:

- o Investigation of groundwater in relation to OU1 contaminants of concern (COCs)
- o Compound-specific isotope analysis (CSIA) sampling and evaluation.
- Subsurface profiling of VOC concentrations and subsurface characteristics using membrane interface probe/electric conductivity/hydraulic profiling tool (MIP/EC/HPT) logging techniques.
- o Geophysical Survey
- Collection soil and groundwater samples collected from direct push technology (DPT)borings.
- o Installation of groundwater monitoring wells.
- o Sample Numbering System.
- o Documentation.
- o Decontamination Procedures.
- o Investigation derived waste (IDW) Management.

1.1 Site Location and Description

The Ogallala Groundwater Contamination site (Comprehensive Environmental Response, Compensation, and Liability Information System ID No. NED986369247) is in Ogallala, Nebraska, in Keith County in west central Nebraska (Figure 1-1). The city of Ogallala has an estimated population of 5,100 and lies just north of the South Platte River. The Ogallala Groundwater Contamination site consists of an aquifer contaminated with industrial chemicals, primarily chlorinated volatile organics. Depth to groundwater at the site ranges from 9 to 17 feet below ground surface (bgs).

The Site consists of an aquifer contaminated with industrial chemicals, primarily chlorinated volatile organic compounds (VOC). Contamination at the Site was discovered in 1989 when the

Nebraska Department of Health (NDOH) detected chlorinated industrial solvents in Ogallala's water supply wells during routine sampling. Subsequent sampling of the municipal water supply detected contamination exceeding Maximum Contaminant Levels (MCL) in seven of Ogallala's nine water supply wells. The chemicals of concern (COCs) present in the municipal wells included benzene, chloromethane, 1,1-dichloroethene (1,1-DCE), PCE, and TCE.

The Site consists of two project areas called operable units (OUs). OU1 consists of chlorinated solvent contamination in groundwater from sources located at or near the following facilities: American Shizuki Corporation (ASC), Helmuth Cleaners, Ogallala Electronics and Manufacturing, Inc. (OEMI), and the former TRW Inc. (TRW)/Goodall Facility. OU2 includes the Tip-Top Cleaners source area located at 116 West 5th Street and the tetrachloroethene (PCE) groundwater plume extending southeast from the source area approximately one- half mile (Section 6, Township 13 North, Range 38 West).

OU1 consists of groundwater contamination along the business corridor of Highway 30 and beyond in the direction of the former city landfill and the northernmost lake of those labeled Gravel Pits (also known as Gravel Pit Lake). Commercial, residential, and agricultural land uses surround the Site.

OU1 includes TCE and carbon tetrachloride (CT) plumes in the Alluvial and Ogallala aquifers extending east-southeast across the south-central part of town. TRW (Northrop Grumman Systems Corporation is the current successor), ASC, and OEMI are identified as the settling defendants in the OU1 Consent Decree (CD). The OU1 ROD identified the ASC (former TRW) facility at 301 West O Street and the OEMI facility at 601 West 1st Street as two of several potential sources of contamination. Additional potential source areas were investigated by the NDEQ and the Potentially Responsible Party (PRP) Group in 2011. The area located between West E and West C Streets and just north of Highway 30 (1st Street) is another likely potential source, based on these investigations. However, there are other potential source areas, some that have not been investigated due to ongoing right-of-entrynegotiations.

1.2 Site History and Previous Investigations

Contamination was discovered in 1989 when the NDOH sampled the Ogallala public water supply system during routine sampling. Contamination was present in five of the town's nine water supply wells. In 1990, the Nebraska Department of Environmental Quality (NDEQ) conducted a soilgas investigation and groundwater sampling in Ogallala to determine sources for the groundwater contamination. Based upon this survey, several source areas were identified. As part of the 1990 survey, groundwater samples were collected from 16 private wells and VOCs were detected in four of those wells. Three of the wells were used for irrigation only. The fourth well was a drinking water

well. None of the contamination present exceeded MCLs when tested. Residents with a contaminated drinking water well were offered hookups to the City water supply.

Due to the detection of contamination within the municipal supply wells, all wells within the city limits were put on emergency status (use was restricted to fire protection and natural or manmade disasters). On February 2, 1993, NDOH issued an Administrative Order to the city of Ogallala ordering compliance with the MCLs for their public drinking water source. Under the Administrative Order, the city of Ogallala installed a new well field in 1993 located to the northeast of the city. The Administrative Order was no longer in effect as of February 23, 1996.

In April 1999, the EPA selected the following remedy for OU1 to protect long-term human health and the environment:

- The continued operation of the groundwater extraction and air treatment system, including associated groundwater monitoring.
- Restoration of the Ogallala aquifer through natural attenuation.
- Implementation of institutional controls (ICs) in the form of a city of Ogallala ordinance and deed notices/restrictions on selected properties.
- An inventory of all existing groundwater wells to identify all domestic, irrigation, industrial and monitoring wells in the city of Ogallala and east of Ogallala impacted or potentially impacted by the contaminated groundwater.
- Providing an alternate source of water for domestic use to any residences currently relying on private wells impacted or potentially impacted by the presence of contamination within OU1.
- A groundwater monitoring program which will include periodic groundwater sampling of selected wells identified in the areas of contamination and downgradient from the contamination zones.
- Preparation of a report for OU1, based on eight quarters of groundwater monitoring data, that will evaluate whether natural attenuation is occurring at a rate sufficient to restore the aquifer for beneficial use within an acceptable time frame, not to exceed 20 years.

Groundwater extraction and air stripping treatment ceased operation in 2003. Monitoring is being performed to evaluate the effectiveness of natural attenuation to restore the aquifer to beneficial use within 20 years. The start of the 20-year timeframe began on October 23, 2000, the effective date of the Consent Decree (CD), and the target date for achieving performance standards is October 23, 2020.

In a letter dated October 22, 2009, the EPA advised the PRP Group to undertake additional activities at the Site, after concluding that adequate source control measures had not been implemented and the extent of VOCs in groundwater required delineation. The additional actions suggested by the EPA included further investigation of potential sources; removal of source areas impacting the selected remedy, as appropriate; and horizontal and vertical delineation of the extent of

COCs in groundwater. In response to the EPA's letter, and a meeting held with the EPA and NDEQ on July 29, 2010, the PRP Group submitted a work plan for additional activities. The work plan, dated November 1, 2010, presented a scope of work that included discrete groundwater screening in the downgradient portion of the plume as a delineation measure to optimize monitoring well locations, and discrete groundwater screening at specific locations in the central portion of the plume. Information was used to evaluate potential source areas. These activities were conducted in 2012. Installation of the new monitoring wells will be performed following completion of additional downgradient characterization work.

Recommendations for OU1 in the 2011 five-year review (FYR) were addressed through the following actions during this current FYR period (USACE 2011):

- The downgradient vertical and horizontal extent of chlorinated solvents was addressed with a
 Down Gradient Ogallala Formation Plume Delineation and Focused Screening Level Source
 Investigation. However, this investigation was not able to fully delineate either the vertical or
 the horizontal extent; in fact, a potential source may have been discovered during these
 investigations and, therefore, the issue is still valid.
- Natural attenuation data has not been provided for this FYR period; however, the lack of
 significant concentrations of TCE daughter-products indicates that biodegradation potential
 is very limited. In addition, other sources, including the one identified in the previous bullet
 item, are adding chlorinated volatile organic compounds (CVOC) mass to the OU1 plume,
 making natural attenuation evaluation very difficult to assess.
- Issues regarding the reporting limits and detection limits exceeding the MCL have been resolved by the laboratory.
- The vapor intrusion (VI) issue was investigated at the Arnold Engineering Company facility in 2014, and also on a larger scale in the summer of 2015. The Arnold Engineering Company study indicated that several COCs in the Arnold facility were below human health concern levels. TCE concentrations in groundwater from the eight shallow monitoring wells in the central plume study area were less than 0.9 µg/L. This indicates that groundwater does not appear to represent a potential source of vapor intrusion concern in overlying occupied structures in the upgradient area.
- Source investigations were conducted but were inconclusive, primarily due to right-of- entry (ROE) issues which restricted investigations to City right-of-way (ROW). A potential source was encountered just south of Gravel Pit Lake. Based on this and other findings, the PRPs formally acknowledged that the 20-year RAO is impossible to meet.
- The EPA Region 7 surface water quality standards for TCE and VC have not been exceeded in samples collected from Gravel Pit Lake; however, an investigation of the groundwater/surface water interaction has not been conducted. Surface water samples were

collected by the OU2 contractor until 2014, at which point sampling was discontinued, as evidence indicates that only the OU1 alluvial plume has any impact on Gravel PitLake.

- Sampling for 1,4-dioxane was not conducted as recommended.
- Sampling for VI, including indoor air sampling, is still needed in the mid-plume and downgradient areas.

The second FYR (September 2016) included recommendations to perform a SLERA. A SLERA was performed in September 2017 to evaluate the groundwater/surface water interaction at Gravel Pit Lake. In 2016 a vapor intrusion investigation was continued to evaluate potential indoor air contamination. Investigation activities found indoor air was above EPA action levels in several properties. Vapor mitigation systems were subsequently installed at the properties. The VI investigation described in this current sampling plan will include collection of post mitigation VI samples to confirm proper mitigation, potentially closing out the VI investigation.

Currently the EPA has proposed the use of CSIA to evaluate source areas for the TCE groundwater contamination at the OU1 Site to assist with determining the responsibility among the PRP's. The OU1 site has also been nominated for an optimization review which was completed in October 2018. This FSP and following investigation objectives has been created to incorporate both the CSIA sampling agenda and optimization review recommendations.

1.3 Summary of Conceptual Site Model and Data Gaps

The city of Ogallala is a regional center for light industry, including agricultural machinery, grain storage, metal salvage and electronics. Several historical industrial activities are potential primary sources of chlorinated solvents. Identification of potential sources during the RI focused on larger industrial users of chlorinated solvents; including American ShiZuki Corporation (ASC) at 301 West O Street and Ogallala Electronics and Manufacturing, Inc. (OEMI) at 601 West 1st Street (W. 1st Street). Additional potential source areas of TCE include commercial property near the corner of West D Street and West 1st Street (Schmidt/Humphrey's area) and in the city block between West 1st Street and West Railroad Street and West A Street and North Spruce Street. Potential sources in the eastern portion of the plume have also been investigated including a former grain elevator, the former city dump, and U.S. Recycling, a metal recycling facility

The primary contaminant of concern (COC) in terms of concentrations above remedial goals and distribution is TCE. Other COCs include carbon tetrachloride, likely originating from historical fumigation at grain handling facilities, and tetrachloroethene (PCE).

The city of Ogallala is on the north bank of the South Platte River, which rises to a terrace created by the ancestral river. The topography across the Site slopes gradually from west to east parallel to the South Platte River. Site stratigraphy consists of the following general layers:

- Surficial soils composed of silt and loam.
- Alluvial unit located below the surficial soil from about 5 feet (ft) to between 20 and 30 ft below ground surface (bgs); groundwater is encountered between 7 and 12 ft bgs and is unconfined. The saturated portion of the alluvial unit is the uppermost saturated unit at the Site.
- Ogallala Formation is the saturated unit below the alluvial unit. The Ogallala Formation includes the Ash Hollow Member, a discontinuous layer of semi-consolidated clay, silt, and sand at depths between 32 and 47 ft bgs. Cemented caliche is observed in some areas.
- The upper saturated Ogallala Formation below the Ash Hollow Member consists of highly heterogeneous sands to silty sands with fine gravel with interbedded clay seams. The thickness of the upper Ogallala Formation ranges from 40 to 60 ft. A silt and clay layer is observed at about 90 ft bgs ranging in thickness between 0 and 20 feet. The 90-foot clay is considered the boundary between the Upper and Lower Ogallala layers.
 - The lower saturated Ogallala is below the 90-foot clay layer.

The regional direction of groundwater flow through the South Platte River Valley is from west to east/southeast with a hydraulic gradient on the order of 0.0015 feet/foot (ft/ft) for both the alluvial and Ogallala aquifers. Under natural flow conditions, no vertical gradients are observed between the alluvial and Ogallala aquifers; however, historical pumping from municipal wells historically located within and around the plume likely created downward gradients pulling contamination from the alluvial to the Ogallala aquifer.

ASC, located at the eastern limit of the plume, implemented voluntary cleanup actions in 1994 including installation and operation of the GWETS. The GWETS consisted of three groundwater recovery wells screened in the Ogallala aquifer with treatment by a shallow-tray air stripper. The extraction wells were located on the adjacent Keith County Fairgrounds property. The GWETS was terminated by 2005 with EPA approval after a two-year verification sampling program.

In 2005, the PRPs completed a preliminary treatability study using in situ chemical oxidation (ISCO) in the area of OEMI to determine if this technology would address residual contamination in groundwater. Additional injections were completed in 2007. Monitoring results indicate an initial drop in TCE concentrations in the area of ISCO applications, but concentrations have subsequently rebounded at several sampling locations.

The priority data gap in the CSM is uncertainty about the location and magnitude of sources of TCE. In October 2009 EPA requested that the PRPs conduct additional response actions. However, uncertainty about on-going sources prevents design of effective remedial systems. Multiple primary source investigations have been completed at the Site. In addition to the preliminary investigations (the RI/FS and data collected to support the ROD) recent source investigations have been conducted by EPA contractor TetraTech in 2014 and 2018, and on a voluntary basis by the PRP group (Stantec, 2016 and 2017b).

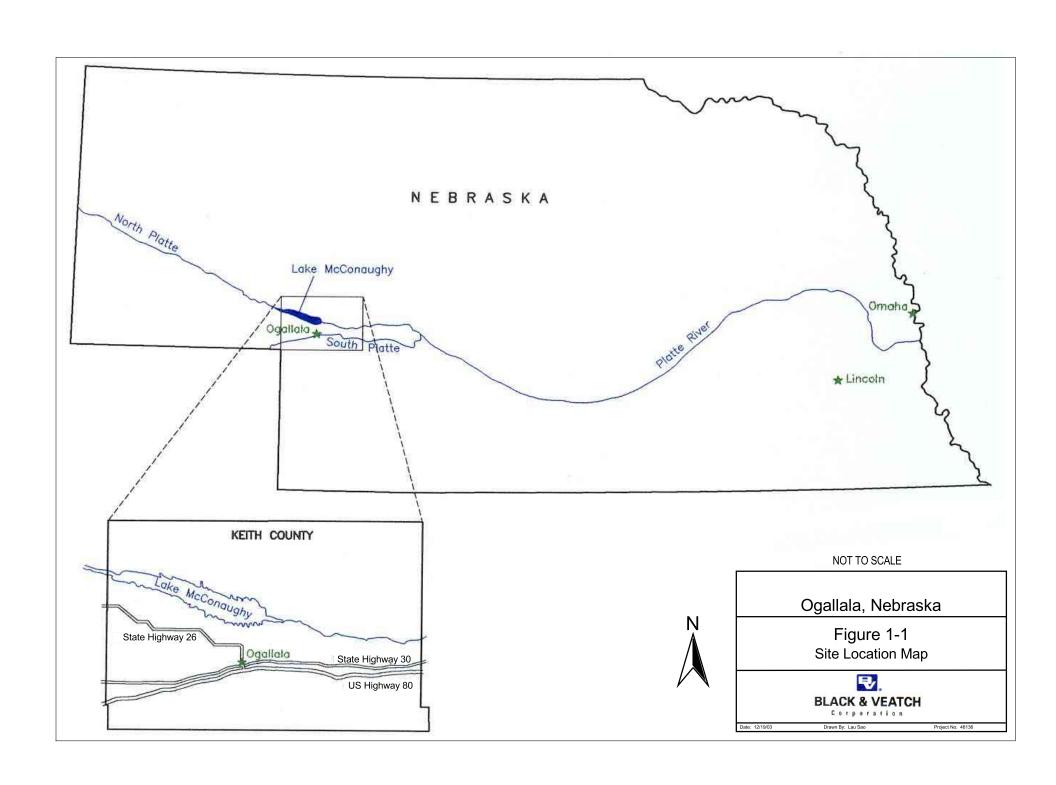
The highest recent TCE concentrations measured in the shallow alluvial aquifer have been recorded at well AL-1-04 (>2,000 µg/L) at the corner of West D Street and West 1st Street, adjacent to the Schmidt/Humphries buildings. The highest concentrations of TCE in the Ogallala aquifer have consistently been recorded at OE-MW-07B in the same location. High concentrations are also observed at wells AL-2-04, T&C-MW-23, and AL-5-05 in a line emanating from the Schmidt/Humphrey's area. These, and other characterization data, support the conclusion that there is an ongoing, shallow, primary source of TCE in the region of West D Street and West 1st Street and perhaps upgradient toward West E Street. The nature and magnitude of the potential source is unknown, and property records do not confirm the presence of industrial operations or an underground tank that could release significant quantities of TCE.

Source characterization at the block containing the TRW/Goodall property, 115 West Railroad Street, and 2 North Spruce Street is incomplete, particularly given the limited number of borings conducted on this block and the elevated soil concentrations (e.g., 990 μ g/kg) and soil vapor concentrations (e.g., 220,000 μ g/m³) detected to date.

The U.S. Recycling facility, located north of EPA-09A/B, was the subject of a removal assessment in 2017 that included soil and soil gas sampling as well as groundwater sampling from temporary Geoprobe wells. Though COCs were found in all media, sampling results do not indicate additional large-scale point sources. This property, along with the abandoned grain elevator east of the Highway 26 Bypass, likely contribute low-level VOCs to soil and groundwater.

Continued high concentrations of TCE, particularly in the area of West 1st Street and West D Street (Schmidt/Humphries); the block containing the TRW/Goodall property, 115 West Railroad Street, and 2 North Spruce Street; and near the former city landfill indicate that there is likely one or more additional primary release areas not addressed under the selected remedy.

Based on alluvial and Ogallala aquifer monitoring data reviewed in the 2017 Progress Report (Stantec, 2017c), the extent of the plumes is not delineated to remedial goals. The current monitoring network does not provide sufficient data to estimate the cross-gradient extent (width) of contamination above the MCL and to estimate total dissolved contaminant mass in the plume. Plume extents depicted in Site documents are not defined by actual sample results, but by modeled extents. Confirmation of the extent of groundwater contamination provides a quantitative benchmark to document remedial progress going forward (EPA 2018).



2.0 Investigation Objectives

The objective of this FSP is to describe components of the RI/FS efforts to be performed at the Ogallala OU1 site that were identified in the *Five-Year Review (FYR)* (EPA 2016) and *Draft Optimization Review Report* (EPA 2018). The proposed efforts are considered necessary before EPA can be certain that the remedy implemented at OU1 is protective. The efforts are proposed to be completed in a phased approach to optimize efficiency for completing project objectives. Activities will include vapor intrusion sampling, investigation of groundwater in relation to potential source areas, isotope fingerprint of OU1 contaminants of concern (COCs), and high-resolution site characterization using MIP/EC/HPT logging techniques. The subsurface profiling will aid in the investigation by identifying target zones for sampling soil and groundwater using DPT borings and the installation of groundwater monitoring wells.

3.0 Investigation Activities

Activities for the Ogallala OU1 RI/FS effort are discussed in this section. It is anticipated that these activities will be accomplished in several separate phases or field mobilizations. The following subtasks are discussed:

- o Investigation of groundwater in relation to OU1 contaminants of concern (COCs)
- o Investigation of contaminant source areas using CSIA.
- o Geophysical Survey
- High Resolution Site Characterization (HRSC) subsurface profiling of VOC concentrations and subsurface characteristics using membrane interface probe/electric conductivity/hydraulic profiling tool (MIP/EC/HPT) logging techniques.
- Collection soil and groundwater samples collected from direct push technology (DPT)borings.
- o Installation and sampling of monitoring wells.
- o Sample Numbering System.
- o Documentation.
- o Decontamination Procedures.
- o Investigation derived waste (IDW) Management.

The samples to be collected are summarized on Table 3-1. Analytical parameters, analytical methods, sample container requirements, preservation methods, and holding times RI/FS sampling are summarized in Table 3-2. Detection limits for the analytical methods are provided in Appendix A. The total number of samples, including duplicates, blanks, and other quality control samples for RI/FS sampling are summarized by sample media in Table 3-3. Specific sample locations are listed by investigation phase in Table 3-4.

<u>Phase 1</u>

The Phase 1 field activities will include collection and analysis of groundwater samples collected from OU1 monitoring wells shown on Figure 3-1, DPT probes at locations shown on Figure 3-2, and a surface geophysical survey. The groundwater monitoring well samples will be selectively analyzed for VOCs; 1,4-dioxane; and CSIA parameters. The rational for the selection of wells for CSIA analysis is presented in Appendix B. Soil and groundwater samples will be collected at indoor and downgradient locations shown on Figure 3-2 using DPT sampling methods. The list of wells and DPT probes including the select analyses are provided on Table 3-4.

A surface geophysical survey is proposed to be performed at the Former City Dump shown on Figure 3-2. The surface geophysical survey will be performed using a magnetometer and ground

penetrating radar to identify anomalies that represent buried drums or underground storage tank. If warranted, the northwest corner of West 1st Street and West D Street will also be surveyed. Additional DPT sampling may be performed at the landfill to investigate the anomalies.

Phase 2

The Phase 2 field activities will include constructing subsurface profiles from MIP/EC/HPT probes, collecting soil and groundwater samples using DPT sample techniques, and mobile laboratory analysis. The MIP/EC/HPT probes will be advanced at locations shown on Figure 3-2. Soil and groundwater samples will be collected and analyzed with an EPA owned and operated DPT rig and mobile laboratory. Proposed locations for the EPA DPT probes will be co-located or placed in close proximity to the proposed MIP/EC/HPT locations shown on Figure 3-2, however, the final locations of the EPA DPT probes will be determined by examination of MIP/EC/HPT subsurface profile and real-time data generated by the mobile laboratory. The MIP/EC/HPT data will also be used to help locate and design new groundwater monitoring wells proposed for installation and sampling during Phase 3. The list of MIP/EC/HPT and DPT probes including the select analyses are provided on Table 3-4.

Phase 3

The Phase 3 field activities will include the installation and sampling of additional groundwater monitoring wells to help monitor the extent of the groundwater contaminant plume. Proposed locations are shown on Figure 3-1 however the location and design of the new groundwater monitoring wells will be completed using data from the MIP/EC/HPT probes and the EPA DPT sample results.

The following general procedures will be practiced when sampling:

- A clean pair of new, disposable nitrile gloves will be worn each time a sample is collected.
- During the course of the field investigation, all samples will be properly documented.
 Documentation will include completion of the chain-of-custody records, field logbook documentation, and sample labels for the sample containers. Samples will be preserved as required, immediately sealed, and kept protected as required.

3.1 Water Level Measurement

The water levels in all OU1 wells and the water surface of Gravel Pit Lake relative to the groundwater elevation will be measured on the same day prior to purging and sampling to determine the groundwater and surface water elevations.

If passive diffusion bags (PDBs) are present in the wells, the PDBs will not be withdrawn until after the water level is measured. The water level, time of measurement, and date will be recorded.

Water level measurements will be conducted as follows:

- (1) Lower the probe of the water level indicator down the well until the meter indicator lights or sounds.
- (2) Measure and record the water level to the nearest 0.01 foot from the top of the PVC riser pipe by reading the measurement directly from the water level meter cable. Also record the time and date of the measurement.
- (3) Decontaminate the water level indicator by spraying the cable with distilled water and wiping with paper towels as the cable is rewound onto the reel.

The surface water elevation of Gravel Pit Lake will be surveyed using MW-11A as a survey reference. The surface water elevation measurement procedure is summarized below. A worksheet for the measurement is provided in Appendix D.

- (1) Position survey level to allow measurement above well MW-11A.
- (2) Place survey rod on top of PVC riser at well MW-11A. Use new glove on bottom of rod to protect well.
- (3) Record survey rod reading at well MW-11A to hundredths foot.
- (4) Place bottom of survey rod at water surface.
- (5) Record survey rod reading with bottom of survey rod at water surface to hundredths foot.

3.2 Monitoring Well Groundwater Sampling

Groundwater sampling methods and protocols will follow those outlined in EPA SOPs (Appendix C). Monitoring wells will be purged and sampled using low flow purging techniques. The wells will be purged using a small submersible pump. Well purging will be performed at approximately 1 gallon per minute (gpm). If the purging equipment needs to be set down, it will be placed in new trash bags to prevent contamination of the equipment. The pump will be set at the upper part of the water column in the well to allow all water in the well water column to be purged from the well.

Pumping will continue until the well meets at least one of two purging criteria that include stabilization of parameters (pH, specific conductivity, and turbidity) OR three times the water volume in the well has been removed. Parameter measurements will be made using a flow-through cell water-quality meter and periodically recorded on purge forms (approximately every 5 minutes) until stabilization occurs. Stabilization will be considered achieved after readings are within the

following limits: ± 0.1 unit for pH, and $\pm 5\%$ for specific conductance, and turbidity is within 10% of the previous reading (target value of less than 10 NTU).

After well purging is achieved samples will be collected from the pump discharge tube prior to flowing through the water meter flow-through cell and at a reduced flow rate. The sample containers will then be filled, and sample management efforts completed. Groundwater samples will be analyzed for site COCs and 1,4-dioxane, a select number of the monitoring wells will also be sampled for CSIA.

3.3 MIP/EC/HPT Subsurface Profiling

Down-hole profiles using a combination MIP/EC/HPT tool will be completed at approximately 42 locations at four distinct areas along the OU1 groundwater plume:

- 1) the area located at West 1st Street and West D Street (Schmidt Motor's);
- 2) the area near Railroad Street and Spruce Street (former TRW/Goodall Electric area);
- 3) downgradient of the former U.S. Recycling facility/Former City Dump; and
- 4) the area west of the Arnold facility.

The MIP/EC/HPT probes are listed on Table 3-4 and the locations are shown on Figure 3-2.

The probe locations will be marked in the field using chalk or other temporary marking material. Utility clearance will be performed for each new probe. The probes will be advanced to an estimated depth of 60 feet bgs at each location. The MIP tool will measure concentrations of chlorinated volatile organic compounds as the tool is advanced into the ground. Measurements will be taken at a rate of approximately 20 measurements per foot advanced. The EC tool will measure the conductance of the surrounding formation as the tool is advanced. The conductivity profile can distinguish between clay and sand units. The HPT tool is able to measure the relative hydraulic pressure of the surrounding formation as the tool is advanced. The information obtained from the profiles will be confirmed by the DPT soil and groundwater samples analyzed by the mobile laboratory and aid in the design of new monitoring wells. When completed the MIP/EC/HPT probes will be backfilled with bentonite chips to the ground surface.

3.4 DPT Sampling

Direct-push sampling will be performed to collect soil core samples and groundwater samples.

3.4.1 DPT Subsurface Soil Sampling Procedures

Subsurface soil core will be collected using DPT techniques to support site characterization. Subsurface soil samples will be selected for VOC analysis from select soil core. Direct-push sampling will be performed using a truck- or van-mounted hydraulic press/hammer, which drives a steel sampling device in the earth to the depth determined in the field. The Phase 1 soil sampling

depths are pre-determined as described below. The Phase 2 soil sampling depths will be determined after MIP/EC/HPT subsurface profiles have been reviewed and analyzed. Soil sampling will be performed using a 4-foot long soil sampler fitted with an acetate liner. The soil core will be logged by the onsite geologist and field screened for signs of contamination using a photoionization detector (PID).

A select number of the Phase 1 DPT probes will be located inside the abandoned building located at 115 West Railroad Street and will be collected using a smaller "dolly" DPT rig. Soil core samples will be collected to approximately 4 feet below the water table (~10 feet bgs). For each indoor probe, one soil core interval above the water table showing the highest PID reading will be collected and submitted to the EPA Region 7 laboratory for VOC analysis. Locations of the indoor sample locations are shown on Figure 3-2.

In Phase 2 the DPT probes will be located at the four areas listed above. Up to 5 soil samples will be collected from the area located at West 1st Street and West D Street (Schmidt's). The sample intervals will be selected based on MIP/EC/HPT results. The total depth (TD) of the probes will be approximately 60-80 ft bgs. The soil core samples will be collected and analyzed onsite by the EPA mobile laboratory. A percentage of the samples will be split and sent to the EPA Region 7 laboratory for confirmation.

Five milligrams of soil will be required in each of two preserved vials using this same soil collection method. Two unpreserved VOC vials will also be collected as part of the sample but will be completely filled and packed to the top with no headspace. The procedure for soil collection for VOC analysis is summarized below:

- 1) The sample cores will be field screened with the PID meter and visual observation. The most contaminated zone in each 4-ft sample interval will be collected for analysis.
- 2) The sampler will collect the VOC sample aliquot from the selected sample zone from undisturbed soils using a modified plastic syringe. The syringe will be modified by trimming the entry end of the syringe.
- 3) The plastic syringe plunger will be withdrawn to the 3 milliliter (ml) increment.
- 4) The syringe will be pushed into the core to collect the soil.
- 5) The syringe will then be withdrawn from the soil core and the soil deposited into a VOC sample vial containing sodium bisulfate preservative using the syringe plunger.

3.4.2 DPT Groundwater Sampling Procedures

Groundwater samples will be collected using DPT techniques and analyzed to evaluate and supplement results of previous investigations.

In Phase 1, DPT probes will be located inside the abandoned warehouse building located at 115 West Railroad Street and at downgradient locations for CSIA analysis. The DPT probes in the

warehouse will be collected using a smaller "dolly" DPT rig. For the warehouse probes, one groundwater sample will be collected at the water table (~10 feet bgs) from each DPT probe and submitted to the EPA Region 7 laboratory for VOC analysis. Locations of the indoor sample locations are shown on Figure 3-2. For the CSIA probes, a groundwater sample will be collected from each DPT at the depth interval indicated in Table 3-4 and as discussed in the CSIA Summary table presented in Appendix B. The CSIA sample aliquots will be submitted to Pace Laboratories for VOC analysis and the OU Laboratory for CSIA analyses. Locations of the CSIA DPT locations are shown on Figure 3-2.

In Phase 2 the DPT groundwater samples will be collected from the four areas described above. Up to 2 groundwater samples will be collected from each probe advanced in the area located at West 1st Street and West D Street (Schmidt's). One groundwater sample will be collected from each probe advanced in the other areas. The sample intervals will be selected based on MIP/EC/HPT historical results. The total depths of the probes will be approximately 60 to 80 feet below ground surface.

The groundwater samples will be analyzed onsite by the EPA mobile laboratory. A percentage of the samples will be split and sent to the EPA Region 7 laboratory for confirmation. The proposed locations of the DPT and MIP/EC/HPT probes are shown on Figures 3-2, however, the locations may change based on results of the MIP/EC/HPT profiles.

The groundwater samples will be collected using the following procedure:

- (1) Direct-push rods will be hydraulically driven to 5 feet deeper than the desired sampling depth with the direct-push system.
- (2) The rods will be retracted five feet to open the 4-foot sample screen. The rods will be driven 1 extra foot to allow the sampling screen extra distance to become caught during retraction. Thin sounding rods will be placed inside the direct-push rods prior to retraction in order to monitor screen depth to ensure the screen becomes exposed during retraction. Once it is confirmed that the sampling screen has been exposed, the sounding rods will be removed.
- (3) A check valve will be attached to 1/2-inch OD polyethylene tubing and inserted through the probe rods and down into the sampling screen. This sampling system assures a contamination-free, leak-proof sampling train.
- (4) The polyethylene tubing is connected to silicon tubing and run through a peristaltic pump. The peristaltic pump is then turned on. If water can be pumped by the peristaltic pump, approximately 1 gallon of water will be purged into a purge water bucket.
- (5) If water does not begin to flow due to the negative pressure created by the peristaltic pump alone then the tubing is pumped by hand in addition to the peristaltic pump.

- (6) The tubing may be withdrawn and re-inserted from the rods several times in order remove sediments from the sampling screen. This method allows the polyethylene tubing and check valve to act as a bailer.
- (7) If water does not flow freely after significant efforts to remove sediment have been made to improve hydraulic connectivity, any water that can be obtained from the interval will be submitted as the sample.
- (8) The sample will be discharged from the tube into the appropriate sample containers and sample management efforts will be completed.

If no water is able to be obtained from a given interval, the interval depth may be adjusted to attempt to find higher conductive zones within the approximate area targeted by the interval. If after such modifications no sample is obtained due to lack of water, the efforts made to obtain the sample will be documented in the log book and the sampling team will progress to the next sampling interval.

3.5 Geophysical Survey

A geophysical survey as proposed in the *Optimization Review Report* will be performed for additional characterization to identify subsurface anomalies such as buried drums or underground storage tanks in the vicinity of the former city dump, that could be potentially contribute to the downgradient portion of the plume. The geophysical survey will include two non-invasive geophysical methods including magnetometry and ground penetrating radar (GPR). The magnetometry method records spatial variation in the Earth's magnetic field to measure polarization of the Earth magnetic field to identify materials constructed of iron. The GPR uses radar pulses to image the subsurface to identify zones of contrasting density to detect subsurface objects, changes in material properties, and voids and cracks. The area to be surveyed is the Former Ogallala City Dump shown on Figure 3-2 and, if warranted, the northwest corner of West 1st Street and West D Street.

3.6 Monitoring Well Installation

Proposed groundwater monitoring well locations will be selected in consultation with the EPA and State. Well locations will be based on the historical groundwater concentration data and MIP/EC/HPT subsurface profiles. New groundwater monitoring well nests will be installed as listed on Table 3-4 and at locations shown on Figure 3-1. The well locations will be marked in the field using chalk or other temporary marking material. Utility clearance will be performed for each new well boring. Each well nest will consist of two wells and installed in separate borings. Borings for wells will be drilled using hollow-stem auger drilling techniques or sonic drilling techniques. The borings will be advanced through unconsolidated material until target depth. Borings will be logged by examination of drill cuttings by the onsite geologist. Each well installation will be logged by an

onsite geologist. The screened intervals for the monitoring wells will be installed across the most contaminated aquifer zones identified from results of the MIP/ EC/HPT profiles and DPT sample results. The water table is expected to be found at ~10 ft bgs.

Wells not completed in one day or wells that remain unattended will be secured to prevent tampering or introduction of any foreign material into the borehole. Monitoring wells will be constructed using 2-inch diameter, polyvinyl chloride (PVC) riser pipe and screen. The riser pipe will be Schedule 40 PVC. The well screens will be 10-foot-long, Schedule 40 PVC with 0.01-inch slots. The annular space around the screen will be backfilled with a silica sand filter pack that will conform to screen gradation analysis requirements of not less than 95 percent of the sand passing US Standard Sieve No. 20 and not more than 5 percent passing US Standard Sieve No. 40. The filter pack will extend from the bottom of the borehole to a minimum of 2 feet above the top of the screen but no greater than 3 feet. The annular space above the filter pack will be backfilled with a minimum of 3 feet of bentonite chips or pellets. The annular space above the bentonite to the surface will be backfilled with cement/bentonite grout tremied into place or bentonite chips or pellets. A locking above-ground or flush-mount protective cover will be used to secure the well head. The concrete surface seal will be sloped to prevent ponding of water on the surface seal. In addition, traffic bollards will be installed around wells as necessary to protect the wells.

Well development will be performed on all newly installed monitoring wells and will consist of surging and pumping the well using an electric submersible pump. For monitoring well installations, the minimum cure time between well completion and development will be 8 hours. In all cases, the care will be taken not to collapse well screens during development activities. Development fluids (fluids recovered from the wells during development) will be managed as described below.

Pumping will continue until the water is clear and free of fines, at least as much water as was introduced during drilling has been removed, and stabilization parameters (pH, specific conductivity, and turbidity) have stabilized. The stabilization parameters should be measured and recorded only toward the end of the development process. Measurements will be recorded periodically until stabilization has occurred. Stabilization will be achieved after the pH and specific conductivity parameters have stabilized for three successive readings within the following limits: ± 0.1 unit for pH and $\pm 5\%$ for specific conductance. Turbidity should be within 10% of the previous reading and have a target of less than 10 NTU. A well development form is presented in Appendix D. The wells will be sampled immediately after development and purging.

After the stabilization parameters (pH, specific conductivity, and turbidity) have stabilized other field parameters (temperature, redox potential (ORP), and dissolved oxygen) should be measured and recorded and VOC samples collected.

3.7 RI/FS Sample Analysis

Several laboratories will be used to analyze various samples collected during the RI/FS sample effort. The laboratories which will perform the monitoring well analyses and confirmation soil and groundwater analysis is listed below. Samples will be collected and managed as summarized in Tables 3-1 to 3-3 and shipped to the laboratory for chemical analyses.

CSIA Groundwater Samples (Monitoring Wells and select DPT probes)

VOC Aliquot

Pace Analytical Services

Attn: 9608 Loiret Blvd, Lenexa, KS 66219 (913)563-1406

CSIA Aliquot

University of Oklahoma School of Geology and Geophysics

Attn: 100 E. Boyd St. Room A119 Norman, OK 73010

(405) 324-3253

Groundwater Monitoring Wells and DPT Confirmation Groundwater/Soil Samples

USEPA, Region 7

Attn: 300 Minnesota Avenue Kansas City, Kansas 66101 (913) 551-5130

3.8 Quality Assurance / Quality Control Samples

Quality assurance / quality control (QA/QC) samples will be collected and evaluated per Table 3-3 to maintain validity of the sample data.

3.8.1 Equipment Rinsate Blanks

Equipment rinsate blanks will be prepared of the groundwater pump and DPT sampling tools. The rinsate blanks will be used to measure the effectiveness of the decontamination procedures of the sampling equipment. The rinsate blanks will be prepared in the following manner:

(1) Pour deionized water or high-performance liquid chromatography (HPLC) water over the sampling equipment and collect directly into the sample containers.

(2) Analyze the rinsate blank for the parameters identified in Table 3-3.

The rinsate blanks will be identified with a sample identification number. The rinsate blank number and time and date of collection will be documented in the field logbook, the sample field sheet, and chain-of-custody record.

3.8.2 Duplicate Samples

Duplicate samples will be collected to assess laboratory QA/QC. The duplicate samples will be collected in the field by alternately filling appropriate sample containers for the primary and duplicate samples. The primary sample and the duplicate sample will be placed in identical containers, preserved in the same manner, and submitted for the same analyses.

The number of duplicate samples may be altered in the field if the actual number of groundwater samples collected by the field team differs from the proposed number. The number of duplicate samples to be collected will be at least 5 percent of the total number of primary samples submitted for analysis for each media.

The duplicate samples will be identified with a sample identification number. The sample location, sample number, and date and time of collection will be documented in the field logbook, the sample field sheet, and on the chain-of-custody record.

3.8.3 Matrix Spike/Matrix Spike Duplicates (MS/MSD)

MS/MSD samples will be collected to evaluate the effect of the sample matrix on the accuracy of the analysis.

Samples are collected in the field by alternately filling appropriate sample containers for the primary, MS, and MSD sample. The primary sample, the MS sample, and the MSD sample will be placed in identical containers, preserved in the same manner, and submitted for the same analyses.

The number of MS/MSD samples may be altered in the field if the actual number of samples collected by the field team differs from the proposed number. The number of MS/MSD samples to be collected will be at least 5 percent of the total number of primary samples submitted for analysis for each media. The MS/MSD samples are collected as additional volume of the primary sample. The sample location, sample number, and date and time of collection will be documented in the field logbook, the sample field sheets, and on the chain-of-custody record.

3.8.4 Trip Blanks

Trip blank samples will be collected to evaluate the potential introduction of VOC contaminants from transportation or storage procedures. Trip blanks are prepared by the analytical laboratory and accompany the shipping coolers and samples until they are received back at the laboratory. One trip blank will be prepared for each field activity that includes VOC sample

collection.

Each trip blank sample will be identified with a sample identification number. The sample number and date and time of collection will be documented in the field logbook, the sample field sheet, and on the chain-of-custody record.

3.9 Sample Numbering System

A sample numbering system will be used to identify each sample submitted for chemical analysis. The purpose of this numbering system is to provide a tracking system for retrieval of information on each sample. The sample identification numbers allocated for all sampling efforts will be used on sample labels, field sheets, sample tracking matrix forms, traffic reports, chain-of-custody records, and all other applicable documentation used during the sampling activity. A listing of all sample identification numbers will be maintained in the field logbook. Each sample collected will be assigned a unique sample number.

Sample identification numbers will consist of four components: the activity number (USEPA assigned), ASR Number (USEPA assigned), the unique sample identification number and the sample qualifier (if applicable). The following is an example of a completely numbered trip blank, with each component identified:

6855-002-FB

where:

6855 = USEPA ASR Number

002 = Sample Identification Number

FB = Sample Qualifier (QC Code)

If the sample is a primary sample, rinsate, or MS, MSD sample, no qualifier will be designated. Rinsate samples will be assigned their own unique identification number and will be noted as a rinsate sample on the field sheet. The MS/MSD samples will consist of additional volume of a primary sample and will be noted as a MS/MSD on the field sheet and chain-of-custody record.

Field duplicate samples will be assigned the same sample identification number as the primary sample but will be qualified as FD. Trip blank samples will be assigned their own unique identification number and will be qualified with FB.

The sample collection field sheets and field logbook included an external sample number which includes information concerning the sample matrix, location, well number, collection date, or sample depth. The external sample number sample matrices will include W (water) or S (soil); sample qualifiers may include D (duplicate), TB (trip blank), MS/MSD (matrix spike/matrix spike duplicate). An example external number is presented below:

W-DPT-1(20-21)-050719-D

where:

W = water
DPT-1 = Direct Push sample DPT-1
(20-21) = sample depth interval
050719 = collection date May 07, 2019
D = duplicate

3.10 Documentation

3.10.1 Field Logbook for Sampling Activities

Information obtained during the sampling activities will be recorded in a bound logbook with consecutively numbered pages. All entries in logbooks and on sample documentation forms will be made in waterproof ink, and corrections will consist of line-out deletions that are initialed and dated.

Sampling situations vary widely. No general rules can specify the exact information that must be entered in a logbook for a particular site. However, the logbook must contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory. The logbooks must be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

3.10.2 Photographs

Site activities may be photographed. Each photograph will be logged in the field logbook to reference and identify what is depicted in each photograph. The photograph may include an informational sign describing the subject matter of the photograph. Logbook entries of photographs will include the photographer's initials, date, and subject matter.

For example: JT, 05-07-19, Sample SD-1.

3.10.3 Sample Documentation

The following subsections describe the required sample documentation and the procedures for completing these documents. The documents will be used for each environmental sample collected for chemical analysis.

3.10.3.1 Sample Labels

An adhesive sample label will be placed on each sample container submitted for chemical analysis. The following information will be included on each sample label:

Site name.

Sample number.

Name of sampler.

Sample collection date and time.

Analysis requested and preservatives added.

Information known before field activities (i.e., site name, sample numbers, etc.) may be preprinted on the sample labels. Duplicate sample labels will be prepared for cases when various aliquots of a sample must be submitted separately for individual analyses. An example label is shown in Appendix D.

3.10.3.2 USEPA Region 7 Field Sheet

The USEPA Region 7 field sheet will be used during sample collection in order to document sample collection time, location, and field observations. An example field sheet is provided in Appendix D.

3.10.3.3 Chain-of-Custody Record

A chain-of-custody record will be completed for each sample shipment. Standard USEPA Region 7 laboratory chain-of-custody records will be used. An example form is shown in Appendix D. After completion of the chain-of-custody-record, a photocopy of the chain-of-custody will be made and both copies of the original chain-of-custody record will be enclosed in a sealable plastic bag and secured to the inside of the shipping container lid. The photocopy will be retained for reference before receipt of the original forms with the laboratory's data deliverable package. The original chain-of-custody record received from the laboratory will be placed in the final project file.

Shipping containers will be secured, and custody seals will be placed across the container openings. As long as the chain-of-custody record is sealed inside the shipping container and the custody seals remain intact, commercial carriers will not be required to sign the chain-of-custody record.

3.10.3.4 Custody Seals

Custody seals will be used to ensure the integrity of the samples should they remain unattended or when they are relinquished to a delivery service until they are opened by the laboratory. All samples will be shipped in an insulated shipping container, and each shipping container will be sealed with at least two custody seals. The seals will be affixed to each shipping container so that it is necessary to break the seals to open the shipping container. An example of a custody seal is shown in Appendix D.

3.10.3.5 Sample Receipt Form

If split samples are provided to another party, a receipt for samples form will be completed. After completion of this form, the original copy, which is to be signed, will be retained for the project file, and a copy will be given to the sample receiptent. An example of a sample receipt form is shown in Appendix D.

3.10.3.6 Airbill

An airbill will be completed for each cooler shipment. Next morning overnight delivery will be indicated on the airbill by the field personnel shipping the samples. More than one shipping container may be forwarded to the same address under one airbill. When the shipping containers are relinquished to the delivery service, additional information will be added to the airbill by an employee of the delivery service, and a copy of the airbill will be received by the field personnel. An example of a completed airbill is shown in Appendix D.

3.11 Decontamination Procedures

Procedures for equipment decontamination will be implemented to avoid cross-contamination of subsurface strata and samples of various media that are to be submitted for chemical analysis. Sampling equipment will be thoroughly cleaned and decontaminated before initial use and between sample locations.

3.11.1 Initial Decontamination

Initial decontamination of the sampling equipment will include the following:

- (1) Wash with dilute Alconox® wash.
- (2) Rinse with potable water.
- (3) Rinse with distilled water.

3.11.2 Intermediate Decontamination

Intermediate decontamination of the sampling equipment will be required between sampling attempts. The intermediate decontamination procedures for sampling equipment are the same as those outlined in the initial decontamination.

3.11.3 Final Decontamination

Final decontamination of all sample equipment will be performed before equipment demobilization from the site. Final decontamination is required to prevent contaminants from being

carried offsite. The procedures used during initial decontamination will be utilized during final contamination.

3.12 Site Survey

The horizontal locations where the samples are collected will be surveyed using GPS based equipment or surveyed relative to adjacent topographic features.

For the newly installed monitoring wells the locations and top of casing elevations will be surveyed by a licensed surveyor to within 0.01 foot and ground elevations. Horizontal (XYZ) coordinates will be established by a licensed surveyor to within 0.1 foot using the notched reference point for monitoring wells. The Absolute Location of new sample points will be determined relative to the World Geodetic System 1984 (WGS84). WGS84 is the reference coordinate system used by the Global Positioning System. Elevations are referenced to mean sea level (msl) North American Vertical Datum (NAVD) of 1988. All surveying work will be performed during the Phase 1 through Phase 3 work, or within 3 months of the completion of the work.

Table 3-1 Investigation Summary RI/FS

Ogallala Groundwater OU1 Site

Effort	Quantity	Depth	Analyses
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PHASE 1

DPT PROBES							
DDT	5 CSIA Probes (GW)	Estimate 60 ft bgs TD for CSIA	Groundwater CSIA and VOCs				
DPT	5 Warehouse Probes (GW and Soil)	Estimate 20 ft bgs TD at Warehouse	Groundwater and Soil VOCs				
	MONITOR	ING WELLS					
Sample Existing	20	Varies (See Table 3-4)	CSIA TCL VOCs 1,4-dioxane Field Parameters (Fe(II), T, pH, sc, DO, ORP, turbidity)				
Wells	20	Varies (See Table 3-4)	TCL VOCs 1,4-dioxane Field Parameters (Fe(II), T, pH, sc, DO, ORP, turbidity)				
SURFACE GEOPHYSICS							
Surface Geophysics 2 Techniques		NA	Magnetometry and GPR				

PHASE 2

MIP/EC/HPT and DPT PROBES							
MIP/EC/HPT	42 (26 at Schmidt's; 10 at TRW/G; 5 at U.S. Recycle; and 1 West of Arnold Area)	Refusal; estimate 60- 80 ft bgs each	XSD/PID/MIP detector				
DPT	~62 GW (at MIP/EC/HPT probes listed above); 5 soil at Schmidt area	Refusal; estimate 60- 80 ft bgs each	Groundwater and Soil VOCs				

Table 3-1 (Continued) Investigation Summary RI/FS Ogallala Groundwater OU1 Site

Effort	Quantity	Depth	Analyses
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PHASE 3

MONITORING WELLS							
Install/Sample Shallow Wells	7	Screen intervals TBD from MIP/EC/HPT logging; estimate 30- 40 ft bgs shallow wells	TCL VOCs 1,4-dioxane Field Parameters				
Install/Sample Deep Wells	8	Screen intervals TBD from MIP/EC/HPT logging; estimate 70-80 ft bgs deep wells	(Fe(II), T, pH, sc, DO, ORP, turbidity)				

Table 3-2

Analytical Parameters and Methods, Containers, Preservatives, and Holding Times RI/FS

Ogallala Groundwater OU1 Site

Parameter	Method	Method Detection Limits	Container Requirements	Preservative	Holding Time				
	GROUNDWATER SAMPLES								
LDL VOCs ¹	LDL TCL by EPA Method 8260B ⁽¹⁾	Varies ²	3@40ml vials	HCl pH <2, 4°C	14 days				
1,4-Dioxane	RLAB by EPA Method 8270C SIM	0.45 μg/L	128 oz glass amber	4°C	7 days				
CSIA	EPA600/R-08/148	Varies	9@40ml vials	HCl pH <2, 4°C	60 days				
T, sc, pH, DO, ORP, Fe (II) and turbidity	Field Measurement	Varies	Field	NA	NA				
SOIL SAMPLES									

LDL VOCs ¹	LDL TCL by EPA 8260B	Varies ²	4@40ml VOA vials	4°C, sodium bisulfate (2 vials), methanol (1 vial)	14 days
TCLP LDL VOCs ¹	TCLP for VOCs	Varies ²	4@40ml VOA vials	4°C, sodium bisulfate (2 vials), methanol (1 vial)	14 days

LDL - low detection limit

VOC - volatile organic compound

NA - not applicable

T - temperature

 $sc-specific\ conductivity$

pH - potential of hydrogen

DO - dissolved oxygen

ORP - oxidation reduction potential

Fe (II) - ferrous iron - field test kit

CSIA - compound specific isotope analysis

TCLP - Toxicity characteristic leaching procedure

Note 1 - VOC samples to be analyzed at low concentration (LDL) organic analytical service for Superfund (water matrix) see Appendix A

Note 2 - See Appendix A

Table 3-3 Sample Summary RI/FS Ogallala Groundwater OU1 Site

	Number	Number of	Number of	Number of	Number	Number of	Total
Parameter	of Primary	Trip	Number of Duplicates	Rinsates	of Matrix	Matrix Spike	Samples
	Samples	Blanks	Bupireaces	Temsaces	Spikes ⁽¹⁾	Duplicates ⁽¹⁾	Sumpres

PHASE 1

MONITORING WELL GROUNDWATER									
R7 Lab VOCs and 1,4-dioxane	20	1	2	2	[2]	[2]	25		
Pace Labs VOCs and 1,4-dioxane	20	1	3	2	[2]	[2]	26		
OU Lab CSIA	20	NA	3	0	NA	NA	23		
T, sc, pH, Fe (II), ORP, and DO	40	NA	NA	NA	NA	NA	NA		
			DPT GROU	NDWATER ²					
R7 Lab VOCs	5	NA	NA	NA	NA	NA	5		
Pace Labs VOCs	5	NA	NA	NA	NA	NA	5		
OU Lab CSIA	7	NA	NA	NA	NA	NA	5		
DPT SOIL ²									
R7 Lab VOCs	5	NA	1	1	[1]	[1]	7		

Table 3-3 (Continued) Sampling Summary RI/FS Ogallala Groundwater OU1 Site

Parameter	Number of Primary	Number of Trip	Number of Duplicates	Number of Rinsates	Number of Matrix	Number of Matrix Spike	Total Samples
	Samples	Blanks	Duplicates	Tembares	Spikes(1)	Duplicates(1)	Sumpres

PHASE 2

DPT SOIL AND GROUNDWATER							
	Groundwater- EPA Mobile Laboratory ⁽³⁾						
VOCs	~62	NA	4	4	[4]	[4]	~70
	10% Confirmation Groundwater-EPA Region 7 Laboratory ⁽⁴⁾						
VOCs	7	1	1	0	[1]	[1]	9
Soil- EPA Region 7 Laboratory							
VOCs	5	NA	1	1	[1]	[1]	7

PHASE 3

MONITORING WELL GROUNDWATER							
R7 Lab VOCs and 1,4-dioxane	15	1	1	1	[1]	[1]	18
T, sc, pH, Fe (II), ORP, and DO	15	NA	NA	NA	NA	NA	NA

LDL - low detection limit

VOC - volatile organic compound

NA - not applicable

T - temperature

 $sc-specific\ conductivity$

pH – potential of hydrogen

DO - dissolved oxygen.

ORP - Oxidation Reduction Potential

Fe (II) - ferrous iron - Hach field test kit

Note 1: MS/MSD samples are additional volume only (indicated by brackets, requires extra sample tags but not extra field sheets).

Note 2: Phase 1 Region 7 Lab DPT VOC samples included with Phase 1 Region 7 Lab monitoring well samples. Phase 1 Pace Labs DPT VOC samples included with Phase 1 Pace Labs monitoring well samples.

Note 3: DPT groundwater samples will be analyzed by the EPA Region 7 mobile laboratory

Note 4: Ten percent of the total groundwater samples collected and analyzed will be sent to the Region 7 Laboratory as confirmation samples.

Table 3-4 Sampling Summary RI/FS

Ogallala Groundwater OU1 Site

PHASE 1

01// 15	Sample Analysis				
OU1 ID	CSIA Analysis	VOC and 1,4-			
	OOI/ (7 triaryolo	Dioxane Analysis			
Water Wells					
	Alluvial Aquifer				
AL-1-04	X	X			
AL-1-05		X			
AL-2-04	X	X			
AL-3-04 AL-4-04	X X	X X			
AL-4-05	X	X			
AL-4-05 AL-5-05	X	X			
ASC-01-A	Λ	X			
ASC-02A-1		X			
ASC-02A-2	X	X			
ASC-03-A	71	X			
ASC-04-A		X			
EPA-09A	X	X			
EPA-11A	X	X			
NW-02A	X	X			
OE-MW-04		X			
OE-MW-05		X			
OE-MW-06		X			
OE-MW-10	X	X			
T&C-MW-23		X			
10001	Ogallala Aquifer				
ASC-01B		X			
ASC-03B	37	X			
EPA-1 EPA-03A	X	X X			
EPA-03A EPA-03B		X			
EPA-03B EPA-09B	X	X			
EPA-11B	Λ	X			
NW-02B	X	X			
OE-MW-01B	71	X			
OE-MW-02B	X	X			
OE-MW-07B	X	X			
OE-MW-08	X	X			
OE-MW-09		X			
MW-2-04		X			
MW-3-04	X	X			
MW-4-04		X			
MW-5-04	X	X			
MW-6-04	X	X			
City/Residential Wells					
City 70		X			
Messersmith		X			

Table 3-4 (Continued) Sampling Summary RI/FS Ogallala Groundwater OU1 Site

PHASE 1 (Continued)

	Sample Analysis				
OU1 ID	CSIA Analysis	VOCs (soil and/or groundwater)			
	Phase 1				
	DPT Sampling				
West of US Recycling					
DPT-CSIA-01	62-63 ft bgs	GW 62-63 ft bgs			
DPT-CSIA-02	33-34 ft bgs	GW 33-34 ft bgs			
DPT-CSIA-03	62-63 ft bgs	GW 62-63 ft bgs			
DPT-CSIA-04	42-43 ft bgs	GW 42-43 ft bgs			
DPT-CSIA-05	52-53 ft bgs	GW 52-53 ft bgs			
Inside Warehouse					
Former TRW/Goodall Electric Area (Spruce Area)					
DPT-BV1		GW and Soil*			
DPT-BV2		GW and Soil*			
DPT-BV3		GW and Soil*			
DPT-BV4		GW and Soil*			
DPT-BV5		GW and Soil*			

^{* =} sample depths as described in Section 3.4: one groundwater sample will be collected at the water table (~10 feet bgs) from each DPT probe and soil core samples will be collected to approximately 4 feet below the water table. For each indoor probe, one soil core interval above the water table showing the highest PID reading will be collected and submitted

Table 3-4 (Continued) Sampling Summary RI/FS

Ogallala Groundwater OU1 Site

PHASE 2

MIP/EC/HPT - DPT Probing					
Probe ID DPT** (soil and/or groundwater)					
MiHpt					
Schmidt Motors (West D St/West 1st St Area) MEH-1 1 X					
MEH-2	1	X X			
MEH-3	1				
	•	X			
MEH-4	1	X			
MEH-5	1	X			
MEH-6	1	X			
MEH-7	1	X			
MEH-8	1	X			
MEH-9	1	X			
MEH-10	1	X			
MEH-11	1	X			
MEH-12	1	X			
MEH-13	1	X			
MEH-14	1	X			
MEH-15	1	X			
MEH-16	1	X			
MEH-17	1	X			
MEH-18	1	X			
MEH-19	1	X			
MEH-20	1	X			
MEH-21	1	X			
MEH-22	1	X			
MEH-23	1	X			
MEH-24	1	X			
MEH-25	1	X			
MEH-26	1	X			
	oodall Electric Area				
MEH-31	1 to 3	X			
MEH-32	1 to 3	X			
MEH-33	1 to 3	X			
MEH-34	1 to 3	X			
MEH-35	1 to 3	X			
MEH-36	1 to 3	X			
MEH-37	1 to 3	X			
MEH-38	1 to 3	X			
MEH-39	1 to 3	X			
MEH-40	1 to 3	X			
US Recycling/ Former Ogallala City Dump					
MEH-51	2	X			
MEH-52	2	X			
MEH-53	2	X			
MEH-54	2	X			
MEH-55	2	X			
West of Arnold Facility					
MEH-60	1	X			

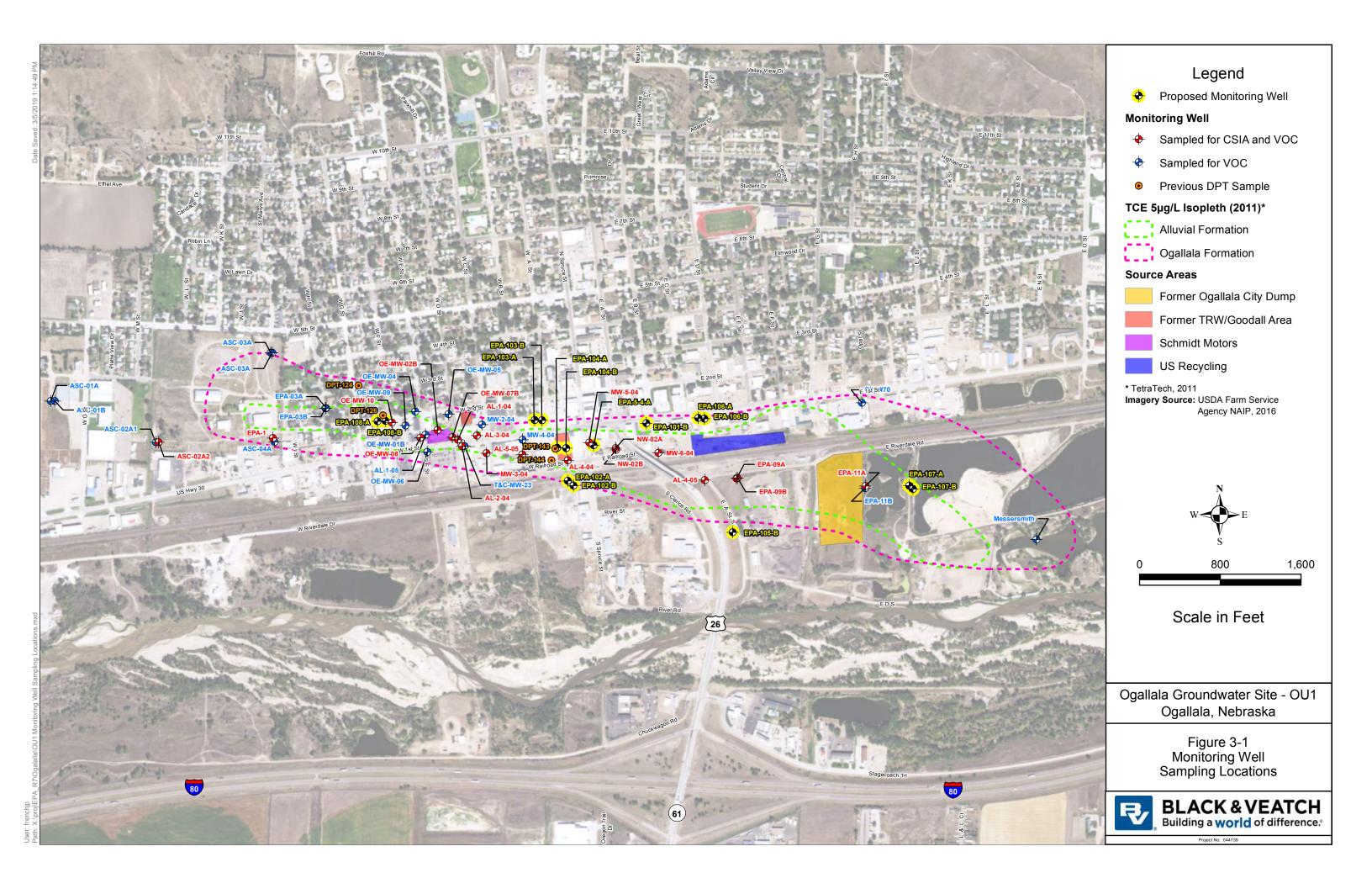
MEH = MIP/EC/HPT = MiHpt

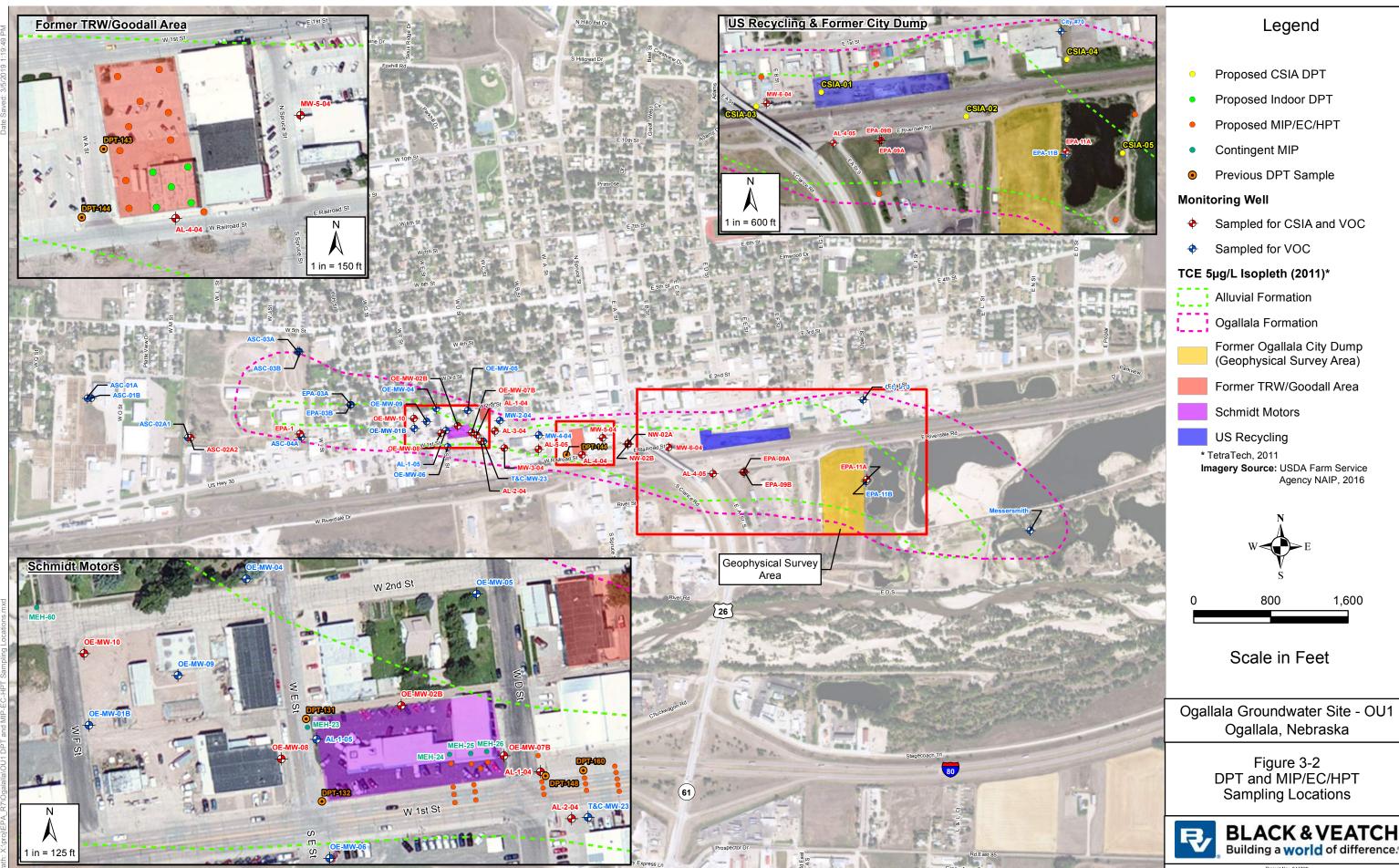
^{** =} sample locations, depths, and media to be proposed by BVSPC using MIP results and confirmed by EPA and NDEQ; estimate \sim 41 to \sim 62 DPT probes

Table 3-4 (Continued) Sampling Summary RI/FS Ogallala Groundwater OU1 Site

PHASE 3

New Monitoring Wells						
Well ID	Approximate	VOC and 1,4-				
Well ID	Depth (ft)	Dioxane Analysis				
Former TRW/Goodall Area (Spruce Area)						
EPA-101-B	80	X				
EPA-102-A	30	X				
EPA-102-B	80	X				
EPA-103-A	30	X				
EPA-103-B	80	X				
EPA-104-A	30	X				
EPA-104-B	80	X				
EPA-5-4-A	30	X				
	US Recycling					
EPA-105-B	80	X				
EPA-106-A	30	X				
EPA-106-B	80	X				
EPA-107-A	30	X				
EPA-107-B	80	X				
West of Arnold Facility						
EPA-108-A	30	X				
EPA-108-B	80	X				





1,600

Ogallala, Nebraska

Sampling Locations



4.0 Investigation-Derived Waste

Investigation-derived wastes will include decontamination fluids, soil cuttings, disposable personal protective equipment (PPE), and trash. All IDW generated by the field activities will be managed in accordance with EPA guidelines and requirements.

4.1 Liquids

Well sampling, development and decontamination fluids will be collected in a holding tank. The fluids will be disposed into the sanitary sewer system for treatment at the wastewater treatment plant. All previous fluid headspace photo-ionization (PID) readings were less than 5 parts per million (ppm) which is expected to be consistent at all existing wells.

4.2 Personal Protective Equipment

Disposable PPE and trash will be bagged in plastic bags and will be disposed of as municipal solid waste.

4.3 Solids

Soil cuttings will be will be segregated from IDW liquids and collected in temporary holding containers. Analytical results of groundwater samples previously collected from the site show low levels relative to hazardous waste characterization concentrations and indicate that the drill cuttings will not be hazardous waste; however, the headspace in the container will be monitored using a PID. If the PID headspace readings are less than 5 ppm, the cuttings will be spread onsite to the ground.

If onsite screening results of the soil cuttings show concentrations greater than or equal to 5 ppm above background, then the cuttings will be placed on plastic sheeting in the secure City of Ogallala Public Works yard and allowed to volatilize for 24 hours. After the 24-hour volatilization period, the cuttings will be re-screened with a PID. If the PID screening results still show concentrations greater than or equal to 5 ppm above background, then the cuttings will be placed in DOT approved 55-gallon drums and staged in the secure City of Ogallala Public Works yard. A waste characterization sample will be collected from the drummed soil cuttings and submitted for VOC toxicity characteristic leaching procedure (TCLP) analysis. If contaminant concentration levels are below TCLP hazardous waste concentrations, the soil cuttings will be spread onsite to the ground as land improvement fill. In cases where contaminant concentrations exceed the TCLP criteria, the soil cuttings will then be disposed as hazardous waste. Regulatory levels for toxicity characteristics by TCLP are: PCE (700 ug/L), TCE (500 ug/L), and vinyl chloride (200 ug/L) as defined under CFR 40 Part 261.24. Regulatory levels for toxicity characteristics by TCLP for 1,2-DCE do not currently exist.

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5.0 Field Activities Schedule

The schedule for the phased approach sample events at the Ogallala OU1 site is provided in Table 5-1. Additional field activities may be scheduled, including sampling efforts at other surface water bodies if results of the investigation indicate additional sampling is necessary to complete the investigation for the site.

Ogallala GW OU1 Site 44818 FSP

Table 5-1 Tentative Field Work Schedule RI/FS Ogallala Groundwater OU1 Site

Person	А		B and C	А	В	А	
Phase 1*	Utility Clearance (B&V DPT, MIP, and EPA DPT) 2 days	B&V DPT Sub 5 CSIA probes (GW) and 5 inside Spruce St warehouse (GW and Soil) 5 days	Geophysical Survey - EM and GPR 4 days	MW sampling - CSIA, dioxane, VOCs 10 days			
Phase 2*					MIP/EC/HPT - utility clearance - 60 ft bgs - 26 probes at West D St/West 1st St Area (Schmidt's); 10 probes at Former TRW/G Area; 5 probes at US Recycle Area 12 days	EPA DPT** - utility clearance - start after MIP probes complete at TRW/G and US Recycle 12 days	
Phase 3-4*							Monitoring Well Installation - 15 wells - depth = 7@30 ft, 8@up to 80 ft 17 days

^{* =} estimated days includes round trip travel

^{** =} EPA Region 7 DPT operator and onsite laboratory operator

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Appendix A

Method Parameters and Detection Limits

United States Environmental Protection Agency Office of Solid Waste and Emergency Response OSWER Document 9200.5-171-FS EPA Publication 540-FS-07-001 August 2007



Multi-Media, Multi-Concentration, Organic Analytical Service for Superfund (SOM01.2)

Office of Superfund Remediation and Technology Innovation (OSRTI) Analytical Services Branch (ASB) (5203P)

Quick Reference Fact Sheet

Under the legislative authority granted to the U.S. Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), EPA develops standardized analytical methods for the measurement of various pollutants in environmental samples from known or suspected hazardous waste sites. Among the pollutants that are of concern to the EPA at such sites are a series of volatile, semivolatile, pesticide, and Aroclor compounds that are analyzed using gas chromatography coupled with mass spectrometry (GC/MS) and gas chromatography with an electron capture detector (GC/ECD). The Analytical Services Branch (ASB) of the Office of Superfund Remediation and Technology Innovation (OSRTI) offers an analytical service that provides data from the analysis of water and soil/sediment samples for organic compounds for use in the Superfund decision-making process. Through a series of standardized procedures and a strict chain-of-custody, the organic analytical service produces data of known and documented quality. This service is available through the Superfund Contract Laboratory Program (CLP).

DESCRIPTION OF SERVICES

This new organic analytical service provides a technical and contractual framework for laboratories to apply EPA/CLP analytical methods for the isolation, detection, and quantitative measurement of 52 volatile, 67 semivolatile, 21 pesticide, and 9 Aroclor target compounds in water and soil/sediment environmental samples. The CLP provides the methods to be used and the specific technical, reporting, and contractual requirements, including Quality Assurance (QA), Quality Control (QC), and Standard Operating Procedures (SOPs), by which EPA evaluates the data. This service uses GC/MS and GC/ECD methods to analyze the target compounds.

Three data delivery turnarounds are available to CLP customers: 7-day, 14-day, and 21-day turnaround after laboratory receipt of the last sample in the set. In addition, there are 48-hour (for trace volatiles and volatiles) and 72-hour (for semivolatiles, pesticides, and Aroclors) preliminary data submission options available. Options under this service include a closed system purge-and-trap method for low-level volatile soil analysis and methanol preservation for medium-level volatile soil analysis. In addition, data users may request modifications to the SOW that may include, but are not limited to, additional compounds, sample matrices other than soil/sediment or water, lower quantitation limits, and other requirements to enhance method performance.

DATA USES

This analytical service provides data which EPA uses for a variety of purposes, such as determining the nature and extent of contamination at a hazardous waste site, assessing priorities for response based on risks to human health and the environment, determining appropriate cleanup actions, and determining when remedial actions are complete. The data may be used in all stages in the investigation of a hazardous waste site including, but not limited to: site inspections; Hazard Ranking System (HRS) scoring; remedial investigations/Feasibility Studies (FSs); remedial design; treatability studies; and removal actions. In addition, this service provides data that will be available for use in Superfund enforcement/litigation activities.

TARGET COMPOUNDS

Table 1 lists the compounds for which this service is applicable and the corresponding quantitation limits. Specific quantitation limits are highly matrix-dependent.

Table 1. Target Compound List (TCL) and Contract Required Quantitation Limits (CRQLs) for SOM01.2*

(Quantitation	Limits					Quantitat	ion Limits			
	Trace						Trace				
	Water by	Trace	Low	Low	Med.		Water by	Trace	Low	Low	Med.
	SIM (µg/L)	Water (µg/L)	Water (µg/L)	Soil (µg/kg)	Soil (µg/kg)		SIM (µg/L)	Water (µg/L)	Water (µg/L)	Soil (µg/kg)	Soil (µg/kg)
VOLATILES						VOLATILES (CON'T)					
1. Dichlorodifluoromethane		0.50	5.0	5.0	250	40. Ethylbenzene		0.50	5.0	5.0	250
2. Chloromethane		0.50	5.0	5.0	250	41. o-Xylene		0.50	5.0	5.0	250
3. Vinyl Chloride		0.50	5.0	5.0	250	42. m, p-Xylene		0.50	5.0	5.0	250
4. Bromomethane		0.50	5.0	5.0	250	43. Styrene		0.50	5.0	5.0	250
5. Chloroethane		0.50	5.0	5.0	250	44. Bromoform		0.50	5.0	5.0	250
6. Trichlorofluoromethane		0.50	5.0	5.0	250	45. Isopropylbenzene		0.50	5.0	5.0	250
7. 1,1-Dicholoroethene		0.50	5.0	5.0	250	46. 1,1,2,2-Tetrachloroethane		0.50	5.0	5.0	250
8. 1,1,2-Trichloro-1,2,2-trifluoroethane		0.50	5.0	5.0	250	47. 1,3-Dichlorobenzene		0.50	5.0	5.0	250
9. Acetone		5.0	10	10	500	48. 1,4-Dichlorobenzene		0.50	5.0	5.0	250
10. Carbon Disulfide		0.50	5.0	5.0	250	49. 1,2-Dichlorobenzene		0.50	5.0	5.0	250
11. Methyl acetate		0.50	5.0	5.0	250	50. 1,2-Dibromo-3-chloropropane	0.050	0.50	5.0	5.0	250
12. Methylene chloride		0.50	5.0	5.0	250	51. 1,2,4-Trichlorobenzene		0.50	5.0	5.0	250
13. trans-1,2-Dichloroethene		0.50	5.0	5.0	250	52. 1,2,3-Trichlorobenzene		0.50	5.0	5.0	250
14. Methyl tert-butyl ether		0.50	5.0	5.0	250		T				
The first control of the control of		0.50	2.0	2.0	200		Low Water		Low		
							by SIM	Low Water	Soil by SIM	Low Soil	Med. Soil
						<u>SEMIVOLATILES</u>	(μg/L)	(μg/L)	(µg/kg)	(μg/kg)	(μg/kg)
15. 1,1-Dichloroethane		0.50	5.0	5.0	250	53. Benzaldehyde		5.0		170	5000
16. cis-1,2-Dichloroethene		0.50	5.0	5.0	250	54. Phenol		5.0		170	5000
17. 2-Butanone		5.0	10	10	500	55. bis-(2-chloroethyl) ether		5.0		170	5000
18. Bromochloromethane		0.50	5.0	5.0	250	56. 2-Chlorophenol		5.0		170	5000
19. Chloroform		0.50	5.0	5.0	250	57. 2-Methylphenol		5.0		170	5000
20. 1,1,1-Trichloroethane		0.50	5.0	5.0	250	58. 2,2'-Oxybis (1-chloropropane)		5.0		170	5000
21. Cyclohexane		0.50	5.0	5.0	250	59. Acetophenone		5.0		170	5000
22. Carbon tetrachloride		0.50	5.0	5.0	250	60. 4-Methylphenol		5.0		170	5000
23. Benzene		0.50	5.0	5.0	250	61. N-Nitroso-di-n propylamine		5.0		170	5000
24. 1,2-Dichloroethane		0.50	5.0	5.0	250	62. Hexachloroethane		5.0		170	5000
25. 1,4-Dioxane			100	100	5000	63. Nitrobenzene		5.0		170	5000
26. Trichloroethene		0.50	5.0	5.0	250	64. Isophorone		5.0		170	5000
27. Methylcyclohexane		0.50	5.0	5.0	250	65. 2-Nitrophenol		5.0		170	5000
28. 1,2-Dichloropropane		0.50	5.0	5.0	250	66. 2,4-Dimethylphenol		5.0		170	5000
29. Bromodichloromethane		0.50	5.0	5.0	250	67. Bis (2-chloroethoxy) methane		5.0		170	5000
30. cis-1,3-Dichloropropene		0.50	5.0	5.0	250	68. 2,4-Dichlorophenol		5.0		170	5000
31. 4-Methyl-2-pentanone		5.0	10	10	500	69. Napthalene	0.10	5.0	3.3	170	5000
32. Toluene		0.50	5.0	5.0	250	70. 4-Chloroaniline		5.0		170	5000
33. trans-1,3-Dichloropropene		0.50	5.0	5.0	250	71. Hexachlorobutadiene		5.0		170	5000
34. 1,1,2-Trichloroethane		0.50	5.0	5.0	250	72. Caprolactam		5.0		170	5000
35. Tetrachloroethene		0.50	5.0	5.0	250	73. 4-Chloro-3-methylphenol		5.0		170	5000
36. 2-Hexanone		5.0	10	10	500	74. 2-Methylnapthalene	0.10	5.0	3.3	170	5000
37. Dibromochloromethane		0.50	5.0	5.0	250	75. Hexachlorocyclo-pentadiene		5.0		170	5000
38. 1,2-Dibromoethane	0.050	0.50	5.0	5.0	250	76. 2,4,6-Trichlorophenol		5.0		170	5000
39. Chlorobenzene		0.50	5.0	5.0	250	77. 2,4,5-Trichlorophenol		5.0		170	5000
* For volatiles, quantitation limits for me						-					

^{*} For volatiles, quantitation limits for medium soils are approximately 50 times the quantitation limits for low soils. For semivolatile medium soils, quantitation limits are approximately 30 times the quantitation limits for low soils.

Table 1. Target Compound List (TCL) and Contract Required Quantitation Limits (CRQLs) for SOM01.2* (Con't)

	Quantitation	Limits					Ouantitati	ion Limits			
	Low Water by SIM (µg/L)	Low Water (µg/L)	Low Soil by SIM (µg/kg)	Low Soil (µg/kg)	Med. Soil (μg/kg)		Low Water by SIM (µg/L)	Low Water (µg/L)	Low Soil by SIM (µg/kg)	Low Soil (µg/kg)	Med. Soil (μg/kg)
SEMIVOLATILES (CON'T)						SEMIVOLATILES (CON'T)					
78. 1,1'-Biphenyl		5.0		170	5000	115. Benzo (a) pyrene	0.10	5.0	3.3	170	5000
79. 2-Chloronapthalene		5.0		170	5000	116. Indeno (1,2,3-cd)-pyrene	0.10	5.0	3.3	170	5000
80. 2-Nitroaniline		10		330	10000	117. Dibenzo (a,h)-anthracene	0.10	5.0	3.3	170	5000
81. Dimethylphthalate		5.0		170	5000	118. Benzo (g,h,i) perylene	0.10	5.0	3.3	170	5000
82. 2,6-Dinitrotoluene		5.0		170	5000	119. 2,3,4,6-Tetrachlorophenol		5.0		170	5000
83. Acenaphthylene	0.10	5.0	3.3	170	5000	PESTICIDES	Water	(µg/L)		Soil (µg/kg)	
84. 3-Nitroaniline		10		330	10000	120. alpha-BHC	0.0)50		1.7	
85. Acenaphthene	0.10	5.0	3.3	170	5000	121. beta-BHC	0.0)50		1.7	
86. 2,4-Dinitrophenol		10		330	10000	122. delta-BHC	0.0)50		1.7	
87. 4-Nitrophenol		10		330	10000	123. gamma-BHC (Lindane)	0.0)50		1.7	
88. Dibenzofuran		5.0		170	5000	124. Heptachlor	0.0	050		1.7	
89. 2,4-Dinitrotoluene		5.0		170	5000	125. Aldrin	0.0)50		1.7	
90. Diethylphthalate		5.0		170	5000	126. Heptachlor epoxide	0.0	050		1.7	
91. Fluorene	0.10	5.0	3.3	170	5000	127. Endosulfan I	0.0)50		1.7	
92. 4-Chlorophenyl-phenyl ether		5.0		170	5000	128. Dieldrin	0.	10		3.3	
93. 4-Nitroaniline		10		330	10000	129. 4,4'-DDE	0.	10		3.3	
94. 4,6-Dinitro-2-methylphenol		10		330	10000	130. Endrin	0.	10		3.3	
95. N-Nitrosodiphenylamine		5.0		170	5000	131. Endosulfan II	0.	10		3.3	
96. 1,2,4,5-Tetrachlorobenzene		5.0		170	5000	132. 4-4'-DDD	0.	10		3.3	
97. 4-Bromophenyl-phenylether		5.0		170	5000	133. Endosulfan sulfate	0.	10		3.3	
98. Hexachlorobenzene		5.0		170	5000	134. 4-4'-DDT	0.	10		3.3	
99. Atrazine		5.0		170	5000	135. Methoxychlor	0	50		17	
100. Pentachlorophenol	0.20	10	6.7	330	10000	136. Endrin ketone	0.	10		3.3	
101. Phenanthrene	0.10	5.0	3.3	170	5000	137. Endrin aldehyde	0.	10		3.3	
102. Anthracene	0.10	5.0	3.3	170	5000	138. alpha-Chlordane	0.0	050		1.7	
103. Carbazole		5.0		170	5000	139. gamma-Chlordane	0.0	050		1.7	
104. Di-n-butylphthalate		5.0		170	5000	140. Toxaphene	5.	.0		170	
105. Fluoranthene	0.10	5.0	3.3	170	5000	AROCLORS	Water	(µg/L)		Soil (µg/kg)	
106. Pyrene	0.10	5.0	3.3	170	5000	141. Aroclor-1016	1.	.0		33	
107. Butylbenzylphthalate		5.0		170	5000	142. Aroclor-1221	1.	.0		33	
108. 3,3'-Dichlorobenzidine		5.0		170	5000	143. Aroclor-1232	1.	.0		33	
109. Benzo (a) anthracene	0.10	5.0	3.3	170	5000	144. Aroclor-1242	1.	.0		33	
110. Chrysene	0.10	5.0	3.3	170	5000	145. Aroclor-1248	1.	.0		33	
111. Bis (2-ethylhexyl) phthalate		5.0		170	5000	146. Aroclor-1254	1.	.0		33	
112. Di-n-octylphthalate		5.0		170	5000	147. Aroclor-1260	1.	.0		33	
113. Benzo (b) fluoroanthene	0.10	5.0	3.3	170	5000	148. Aroclor-1262	1.	.0		33	
114. Benzo (k) fluoroanthene	0.10	5.0	3.3	170	5000	149. Aroclor-1268	1.	.0		33	

^{*} For volatiles, quantitation limits for medium soils are approximately 50 times the quantitation limits for low soils. For semivolatile medium soils, quantitation limits are approximately 30 times the quantitation limits for low soils.

The TCL for this service was originally derived from the EPA Priority Pollutant List of 129 compounds. In the years since the inception of the CLP, compounds have been added to and removed from the TCL, based on advances in analytical methods, evaluation of method performance data, and the needs of the Superfund program. The SOM analytical service combines the previous OLM and OLC services into one method. For example, drinking water and ground water type samples may be analyzed using the Trace Volatiles method in SOM.

METHODS AND INSTRUMENTATION

For trace volatile water samples, 25 mL of water sample is added to a purge-and-trap device and purged with an inert gas at room temperature. For low/medium volatile water samples, 5 mL of water sample is added to a purge-and-trap device and purged with an inert gas at room temperature. Higher purge temperatures may be used for both trace and low/medium volatile analyses if all technical acceptance criteria is met for all standards, samples, and blanks. For low-level volatile soil samples, organic compounds are generally determined by analyzing approximately 5 g of sample in a closedsystem purge-and-trap device at 40EC. For a mediumlevel soil sample, a soil sample of 5 g is collected, preserved, and/or extracted with methanol and an aliquot of methanol extract is added to 5 mL reagent water and purged at room temperature. For water and soil samples, the volatiles purged from the sample are trapped on a solid sorbent. The purged volatiles are subsequently desorbed by rapidly heating and backflushing with helium, and then introduced into a GC/MS system.

For semivolatile, pesticide, and Aroclor water samples, a 1 L aliquot of sample is extracted with methylene chloride using a continuous liquid-liquid extractor or separatory funnel (for pesticides and Aroclors only). For low-level semivolatile, pesticide, and Aroclor soil samples, a 30 g soil/sediment sample is extracted with methylene chloride/acetone using sonication, automated Soxhlet/Dean-Stark (SDS) extraction, or pressurized medium-level extraction techniques. For semivolatile soil samples, a 1g aliquot is extracted with methylene chloride using the techniques mentioned above for low-level soil samples. For both water and soil samples, the extract is concentrated, subjected to fraction-specific cleanup procedures, and analyzed by GC/MS for semivolatiles or GC/ECD for pesticides and Aroclors. Table 2 summarizes the methods and instruments used in this analytical service.

DATA DELIVERABLES

Data deliverables for this service include hardcopy data reporting forms and supporting raw data. In addition to the hardcopy deliverable, contract laboratories must also submit the same data electronically. The laboratory must submit data to EPA within 7, 14, or 21-days after laboratory receipt of the last sample in set [or

preliminary data within 48 hours (for trace volatiles and volatiles) or 72 hours (for semivolatiles, pesticides, and Aroclors)] after laboratory receipt of each sample. EPA then processes the data through an automated Data Assessment Tool (DAT). DAT provides EPA Regions with PC-compatible reports, spreadsheets, and electronic files within 24-48 hours from the receipt of the data for use in data validation. This automated tool also facilitates the transfer of analytical data into Regional databases. In addition to the Regional electronic reports, the CLP laboratories are provided with a data assessment report that documents the instances of noncompliance. The laboratory has 6 business days to reconcile defective data and resubmit the data to EPA. EPA then reviews the data for noncompliance and sends a final data assessment report to the CLP laboratory and the Region.

QUALITY ASSURANCE (QA)

The QA process consists of management review and oversight at the planning, implementation, and completion stages of the environmental data collection activity. This process ensures that the data provided are of known and documented quality.

During the implementation of the data collection effort, QA activities ensure that the Quality Control (QC) system is functioning effectively and that the deficiencies uncovered by the QC system are corrected. After environmental data are collected, QA activities focus on assessing the quality of data to determine its suitability to support enforcement or remedial decisions.

Each contract laboratory prepares a Quality Assurance Plan (QAP) with the objective of providing sound analytical chemical measurements. The QAP must specify the policies, organization, objectives, and functional guidelines, as well as the QA and QC activities designed to achieve the data quality requirements in the contract.

QUALITY CONTROL (QC)

The QC process includes those activities required during analytical data collection to produce data of known and documented quality. The analytical data acquired from QC procedures are used to estimate and evaluate the analytical results and to determine the necessity for, or the effect of, corrective action procedures. The QC procedures required for this analytical service are provided in **Table 3.**

Table 2. Methods and Instruments

Fraction	Water	Soil
Trace Volatiles	Purge-and-trap followed by GC/MS analysis	N/A
Volatiles	Purge-and-trap followed by GC/MS analysis	Purge-and-trap or closed-system purge-and-trap followed by GC/MS analysis
Semivolatiles	Continuous liquid-liquid extraction (CLLE) followed by GC/MS analysis	Sonication, automated SDS extraction, or pressurized fluid extraction followed by GC/MS analysis
Pesticides	CLLE or separatory funnel extraction followed by dual column GC/ECD analysis	Sonication, automated SDS extraction or pressurized fluid extraction followed by dual column GC/ECD analysis
Aroclors	CLLE or separatory funnel extraction followed by dual column GC/ECD analysis	Sonication, automated SDS extraction or pressurized fluid extraction followed by dual column GC/ECD analysis

Table 3. Quality Control (QC)

QC Operation	Frequency
Deuterated Monitoring Compounds (DMCs) (trace volatiles, volatiles, and semivolatiles)	Added to each sample, standard, and blank
Surrogates (pesticides and Aroclors)	Added to each sample, standard, and blank
Method Blanks (trace volatiles and volatiles)	Analyzed at least every 12 hours for each matrix and level
Method Blanks (semivolatiles, pesticides, and Aroclors)	Prepared with each group of 20 samples or less of same matrix and level, or each time samples are extracted by the same procedure
Instrument Blank (trace volatiles and volatiles)	Analyzed after a sample which contains compounds at concentrations greater than the calibration range
Instrument Blank (pesticides and Aroclors)	Every 12 hours on each GC column used for analysis
Storage Blanks (trace volatiles and volatiles)	Prepared and stored with each set of samples
GC/MS Mass Calibration and Ion Abundance Patterns (trace volatiles, volatiles, and semivolatiles)	Every 12 hours for each instrument used for analysis
GC Resolution Check (pesticides)	Prior to initial calibration, on each instrument used for analysis
Initial Calibration	Upon initial set up of each instrument, and each time continuing calibration fails to meet the acceptance criteria
Continuing Calibration	Every 12 hours for each instrument used for analysis
Internal Standards	Added to each sample, standard, and blank
(trace volatiles, volatiles, and semivolatiles)	
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	Once every 20 or fewer samples of same fraction, matrix, and level in a Sample Delivery Group (SDG)
Laboratory Control Samples (LCSs) (pesticides and Aroclors)	Once every 20 or fewer samples of same fraction, matrix, and level in an SDG
Method Detection Limit (MDL)	Determined annually, per matrix and level

PERFORMANCE MONITORING ACTIVITIES

Laboratory performance monitoring activities are provided primarily by ASB and the Regions to ensure that contract laboratories are producing data of the appropriate quality. EPA performs on-site laboratory audits, data package audits, GC/MS and/or GC/ECD tape audits, and evaluates laboratory performance through the use of blind Performance Evaluation (PE) samples.

CONTACTING EPA

For more information, or for suggestions to improve this analytical service, please contact:

Charlie Appleby Organic Program Manager USEPA/ASB Ariel Rios Building (5203P) 1200 Pennsylvania Avenue, NW Washington, DC 20460 703-347-0266

FAX: 703-603-9135

Appendix B

CSIA Sampling Rationale and

Miscellaneous Supporting Data

CSIA Monitoring Well and DPT Sampling Summary RI/FS Ogallala Groundwater OU1 Site

Priority Order	Well	SAMPLE	No. of samples to collect CSIA	No. of samples to collect 8260C	Area	CSIA Dup	8260C Dup	Rationale	TCE last sample (µg/L) [mm/yyyy]
High Priority	Sample Locations	37	1	1 1	TVC A	1	1	TOP : 4 1 1 4 1 G 1: 6	1.0.505/20173
1	EPA-01	Y	1	1	WSA	1	1	TCE consistently detected. Sampling of deeper Ogallala aquifer to investigate relationship to potential source areas @ OEMI, Schmidt Motors, Humphry's Auto Supply and Former TRW/Goodall Facility II	1.9 [05/2017]
2	AL-2-04	Y	1	1	WSA			TCE consistently detected. Sampling near interface of Alluvial and Ogallala aquifers to investigate relationship to potential source areas	220 [05/2017]
3	MW-3-04	Y	1	1	WSA CSA			TCE consistently detected. Sampling in upper Ogallala aquifers to investigate relationship to potential source areas. Common to Central Sampling Area (CSA)	68 [05/2017]
4	AL-3-04	Y	1	1	WSA			TCE consistently detected. Sampling near interface of Alluvial and Ogallala aquifers. Potential source area (Former TRW/Goodall Facility II)	2.3 [05/2017]
5	AL-1-04	Y	1	1	WSA	1	1	TCE consistently detected. Sampling Alluvial aquifer. Potential source area (Humphry's Auto Supply)	600 [05/2017]
6	OE-MW-07B	Y	1	1	WSA			TCE consistently detected. Sampling near interface of Alluvial and Ogallala aquifers. Potential source area (Schmidt Motors)	47 [05/2017]
7	OE-MW-08	Y	1	1	WSA			TCE consistently detected. Sampling near interface of Alluvial and Ogallala aquifers. Potential source area (OEMI)	81 [05/2017]
8	OE-MW-10	Y	1	1	WSA			TCE consistently detected. Sampling near interface of Alluvial and Ogallala aquifers. Potential source area (OEMI)	28 [05/2017]

Ogallala GW OU1 Site FSP

CSIA Monitoring Well and DPT Sampling Summary (Continued) RI/FS Ogallala Groundwater OU1 Site

Priority Order	Well	SAMPLE	No. of samples to collect CSIA	No. of samples to collect 8260C	Area	CSIA Dup	8260C Dup	Rationale	TCE last sample (µg/L) [mm/yyyy]	
9	AL-4-04	Y	1	1	CSA WSA			TCE consistently detected. Sampling Alluvial aquifer. Potential source area (Former TRW/Goodall Facility II)	130 [05/2017]	
10	AL-5-05	Y	1	1	CSA WSA			TCE consistently detected. Sampling Alluvial aquifer. Investigate relationship to potential source areas (Former TRW/Goodall Facility II)	15 [05/2017]	
11	MW-5-04	Y	1	1	CSA WSA			TCE consistently detected. Sampling deeper Ogallala aquifer. Investigate relationship to potential source areas (Former TRW/Goodall Facility II)	72 [05/2017]	
12	NW-02A	Y	1	1	CSA WSA			TCE consistently detected. Sampling Alluvial aquifer. Investigate relationship to potential source areas (Former TRW/Goodall Facility II or WSA)	6.1 [05/2017]	
13	NW-02B	Y	1	1	CSA WSA			TCE consistently detected. Sampling deeper Ogallala aquifer. Investigate relationship to potential source areas (Former TRW/Goodall Facility II or WSA)	240 [05/2017]	
14	EPA-09A	Y	1	1	ESA CSA	1	1	TCE consistently detected. Sampling Alluvial aquifer. Investigate relationship to potential source areas (U.S. Recycling or East Grain Elevator)	26 [05/2017]	
15	EPA-09B	Y	1	1	ESA CSA			TCE consistently detected. Sampling deeper Ogallala aquifer. Investigate relationship to potential source areas (U.S. Recycling, East Grain Elevator, Former TRW/Goodall Facility I or CSA)	380 [05/2017]	
16	DPT CSIA-01 DPT {Near GPW-14 & GPW-15}	Y	1	1	ESA			Recent geo-probe samples where TCE was detected. Sampling Alluvial aquifer. Potential source area (U.S. Recycling). (62-63 ft bgs)	7-22 [03/2017]	

Ogallala GW OU1 Site FSP

CSIA Monitoring Well and DPT Sampling Summary (Continued) RI/FS Ogallala Groundwater OU1 Site

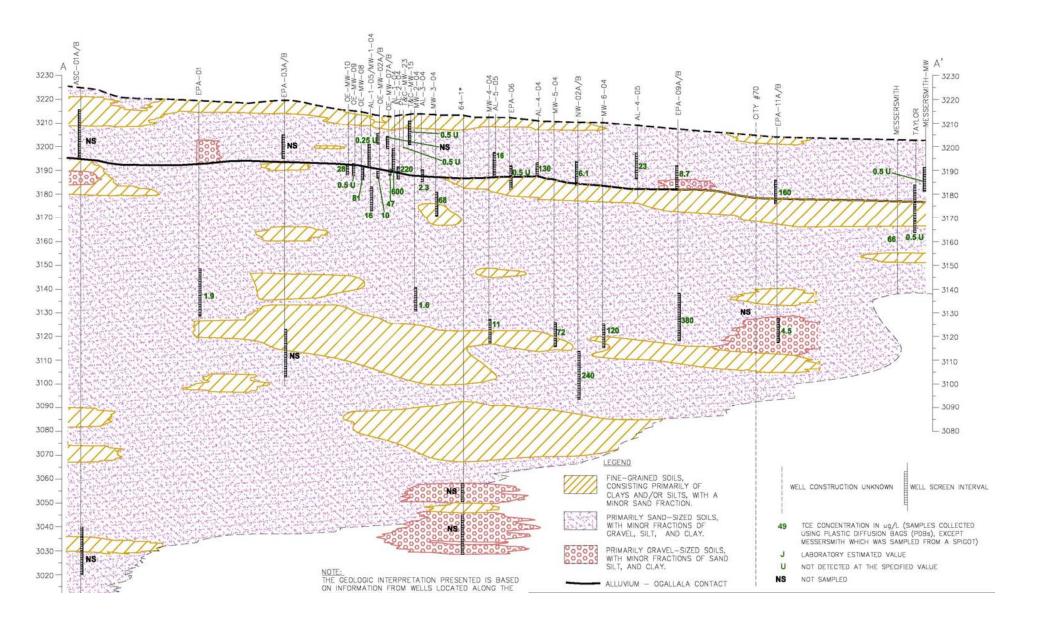
No. of No. of samples samples TCE last sample **CSIA** 8260C **Priority** to collect to collect (µg/L) Order Well **SAMPLE CSIA** 8260C Dup Dup Rationale [mm/yyyy] Area 1* 1* Recent geo-probe samples where TCE >30 [03/2017] 17 DPT Y **ESA** was detected. Sampling Alluvial aquifer. CSIA-02 DPT Investigate shallow plume with source {Near GPW-18 area (U.S. Recycling). This location & GPW-20} would also be favorable for an additional deeper sample based on March 2017 results $(71 \mu g/L @ 33 \text{ ftbgs}).$ 18 DPT Y 1* 1* **ESA** Recent geo-probe samples where TCE >76 [03/2017] was detected. Sampling Alluvial aquifer. CSIA-03 DPT CSA {Near GPW-12} Potential source area (East Grain Elevator). This location would also be favorable for additional deeper samples based on March 2017 results to investigate relationships to other potential source areas (370 µg/L @ 62 ft bgs). Medium Priority Sample Locations 19 EPA-11A Y ESA TCE consistently detected. Sampling >100 [05/2017] Alluvial aquifer. Investigate relationship to potential up-gradient source areas or identify unique source (Former Ogallala City Dump) TCE consistently detected. Sampling Y 120 [05/2017] 20 MW-6-04 1 ESA **CSA** deeper Ogallala aquifer. Investigate relationship to potential source areas (Former TRW/Goodall Facility II, East Grain Elevator) TCE consistently detected. Sampling 23 [05/2017] 21 AL-4-05 Y ESA **CSA** Alluvial aquifer. Investigate relationship to potential up-gradient source areas (Former TRW/Goodall Facility II, U.S. Recycling)

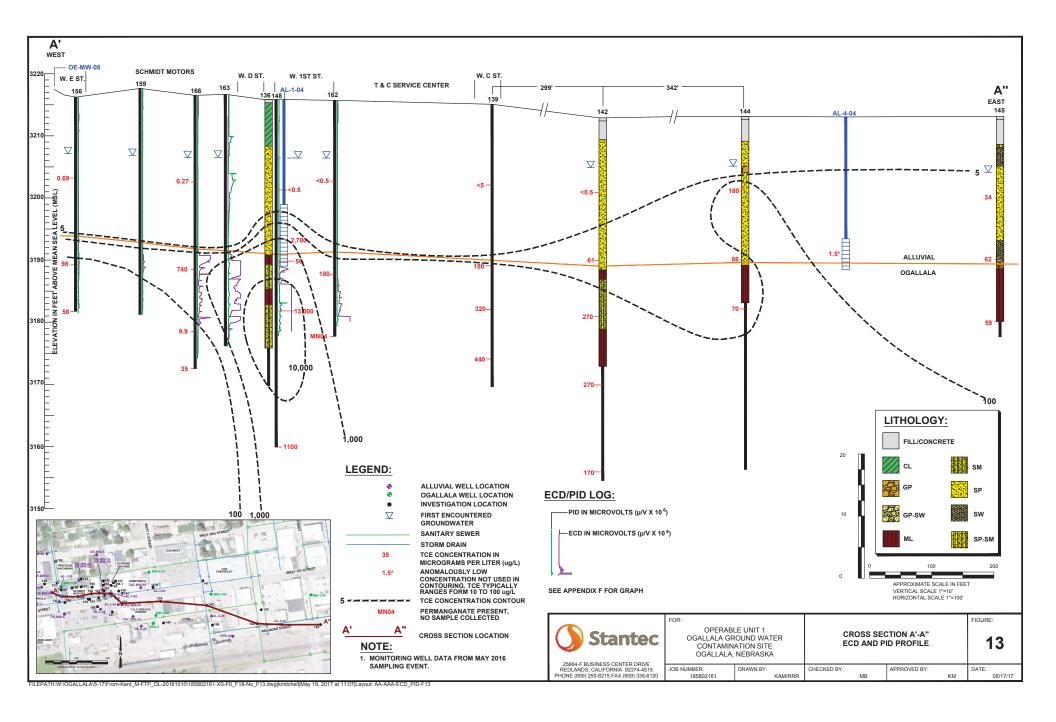
Ogallala GW OU1 Site

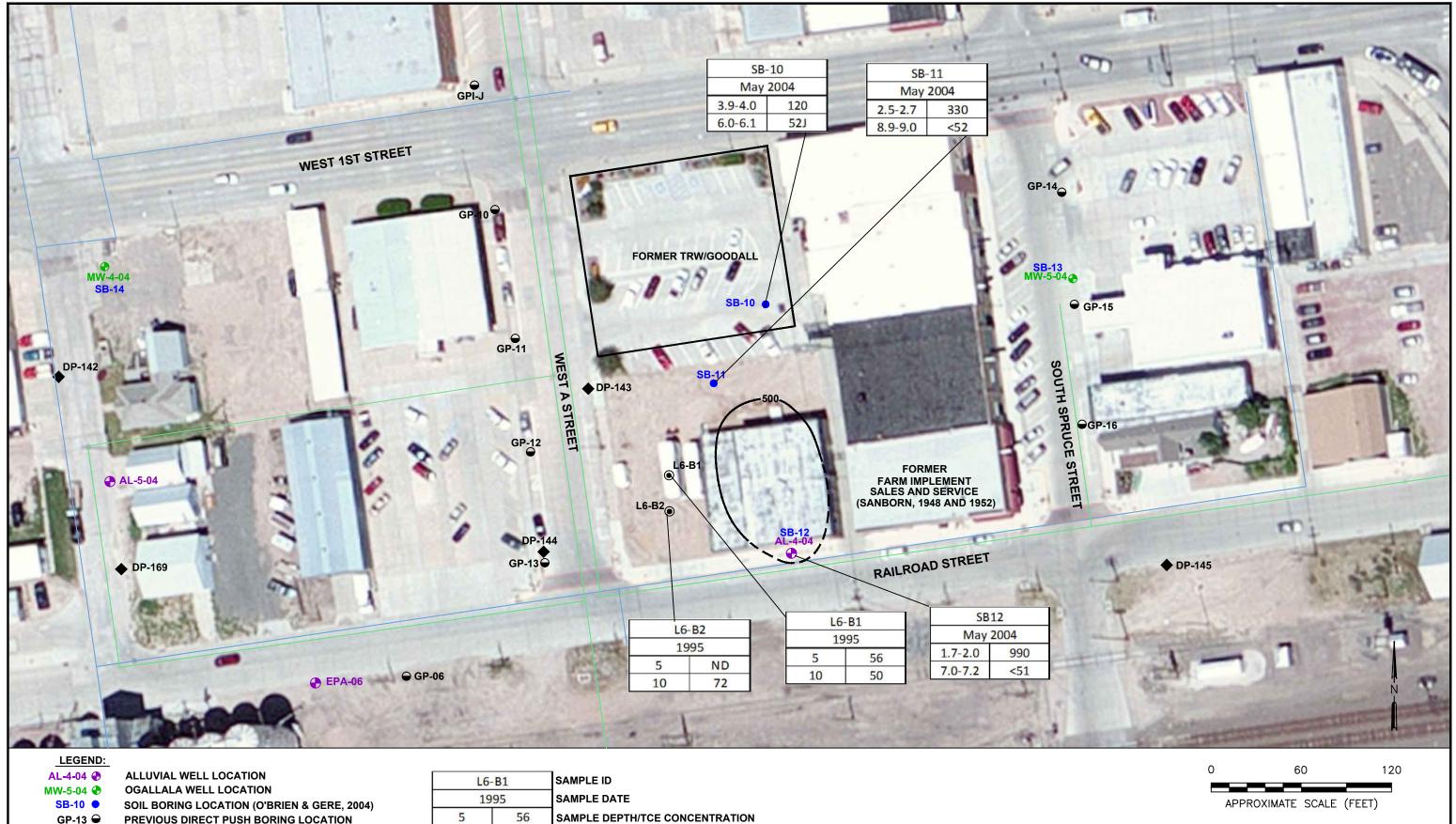
CSIA Monitoring Well and DPT Sampling Summary (Continued) RI/FS Ogallala Groundwater OU1 Site

Priority Order 22	Well OE-MW-02B	SAMPLE Y	No. of samples to collect CSIA	No. of samples to collect 8260C	Area WSA	CSIA Dup	8260C Dup	Rationale TCE consistently detected. Sampling near interface of Alluvial and Ogallala aquifers to investigate relationship to potential source area (Schmidt Motors)	TCE last sample (µg/L) [mm/yyyy] 10 [05/2017]
23	DPT CSIA-04 DPT {Near GPW-24}	Y	1*	1*	ESA			Recent geo-probe samples where TCE was detected. Sampling near interface of Alluvial and Ogallala aquifers. Investigate relationship to nearby source areas. This location would also be favorable for additional deeper samples based on March 2017 results to investigate relationships to other potential source areas (18 µg/L @ 42 ft bgs.	>75 [03/2017]
Low Priority S	Sample Locations								
24	DPT CSIA-05 DPT {Near GPW-30}	Y	1*	1*	ESA			Recent geo-probe samples where TCE was detected. Sampling Ogallala aquifer. Investigate deep plume relationship upgradient source areas (U.S. Recycling). This location would also be favorable for an additional deeper sample based on March 2017 results (84 µg/L @ 52 ft bgs).	>40 [03/2017]

Ogallala GW OU1 Site FSP 448XX







PREVIOUS DIRECT PUSH BORING LOCATION GP-13 👄 (TETRA TECH, OCTOBER 2014)

L6-B2 ● FORMER SOIL BORING LOCATION (FLUOR DANIEL, 1995)

DISCRETE DEPTH GROUNDWATER SAMPLE BORING (STANTEC, 2016) DP-143 ◆

> **SANITARY SEWER** STORM DRAIN

SAMPLE ID	-B1	L6-	
SAMPLE DATE	95	19	
Teamble DEBT	56	7	

10

50

RESULTS IN micrograms per kilogram TCE- TRICHLOROETHENE ND= NOT DETECTED J= ESTIMATED VALUE

— TCE CONCENTRATION CONTOUR

	FOR:
Stantec	

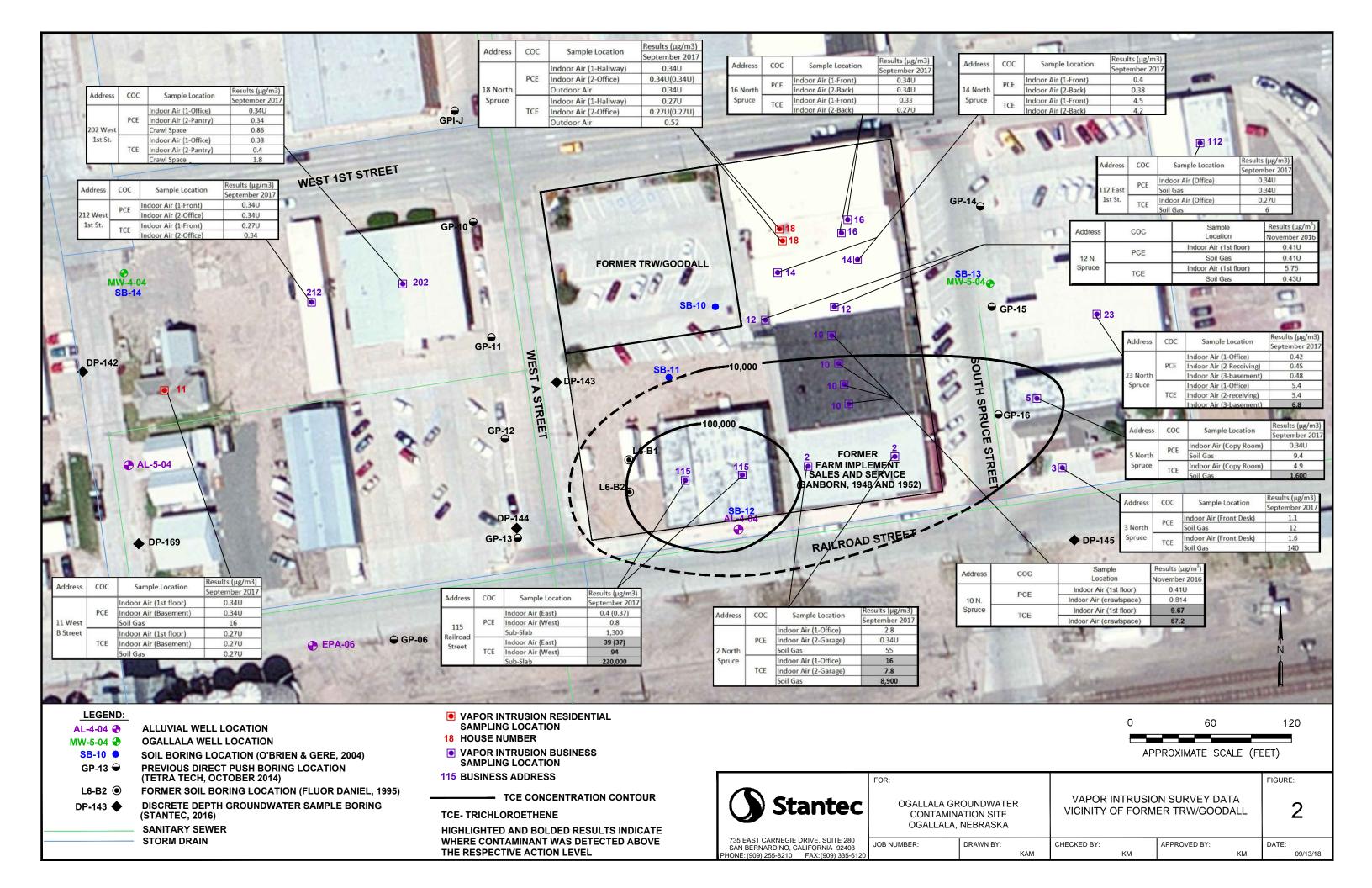
ı	735 EAST CARNEGIE DRIVE, SUITE 280	JOB NUMBER:
ı	SAN BERNARDINO, CALIFORNIA 92408	JOB NUMBER:
	PHONE: (909) 255-8210 FAX: (909) 335-6120	

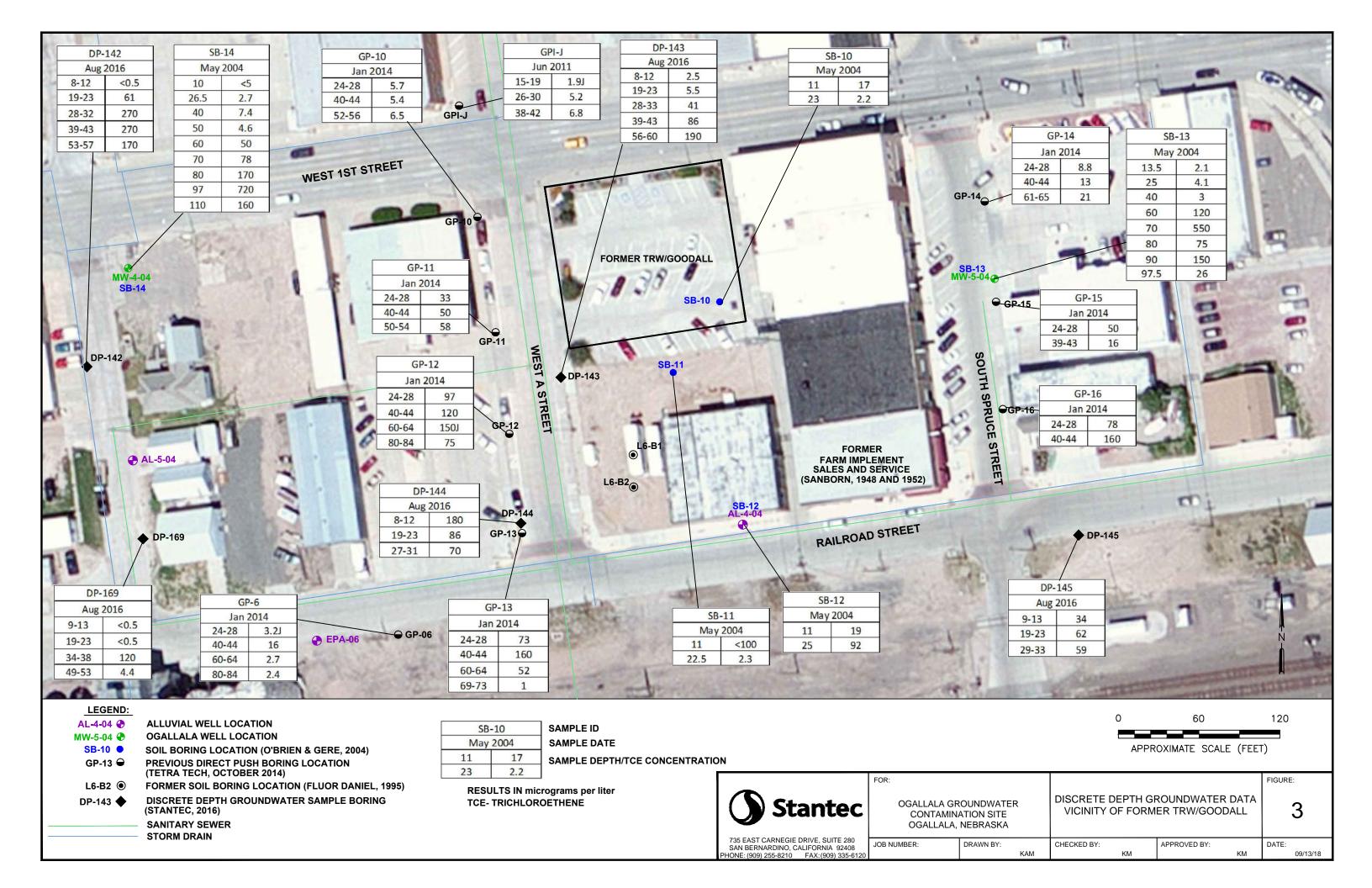
OGALLALA GROUNDWATER
CONTAMINATION SITE
OGALLALA, NEBRASKA

SOIL DATA
VICINITY OF FORMER TRW/GOODALL

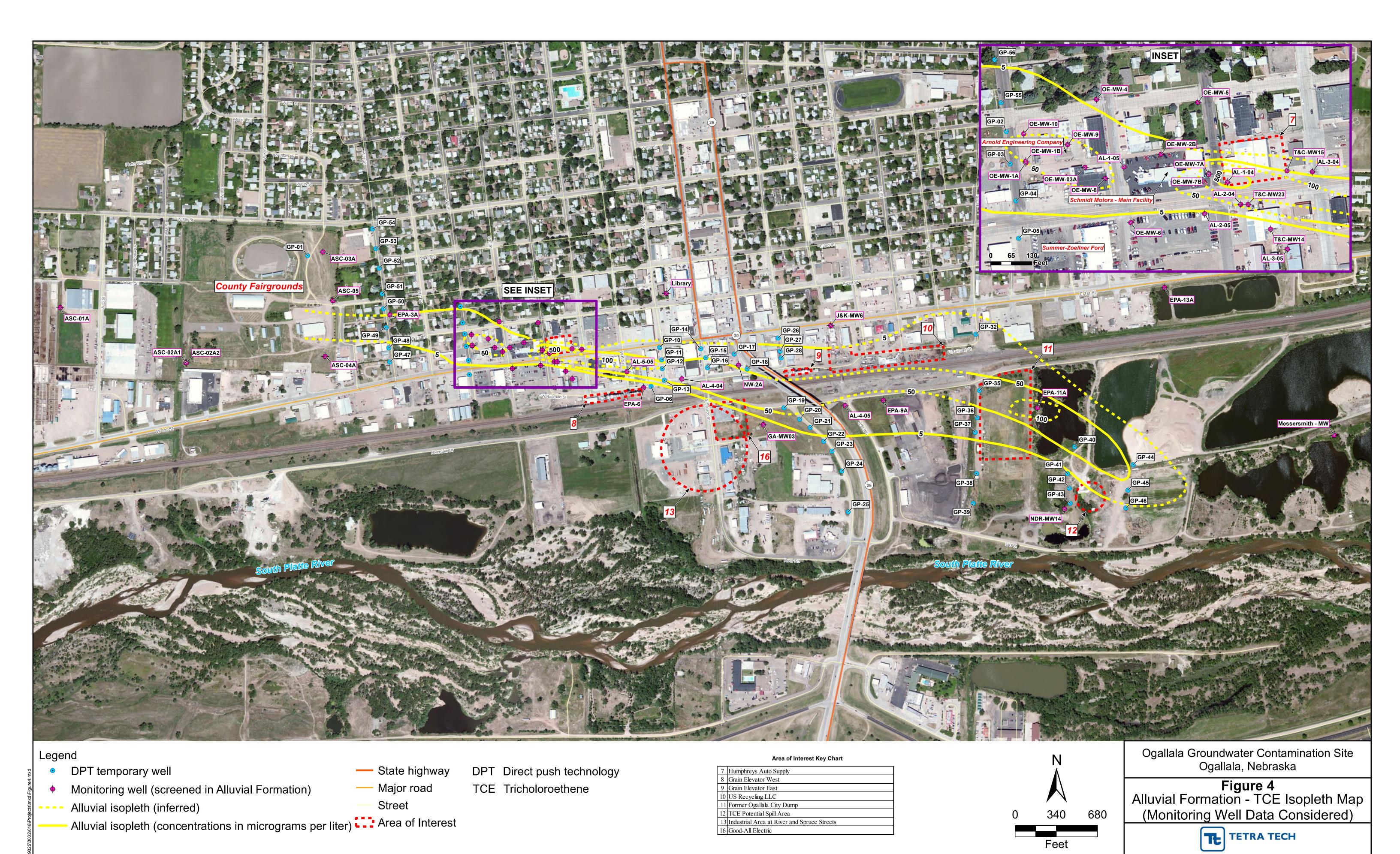
FIGURE:

IEBRASKA							-
DRAWN BY:		CHECKED BY:		APPROVED BY:		DATE:	
	KAM		KM		KM		09/13/18





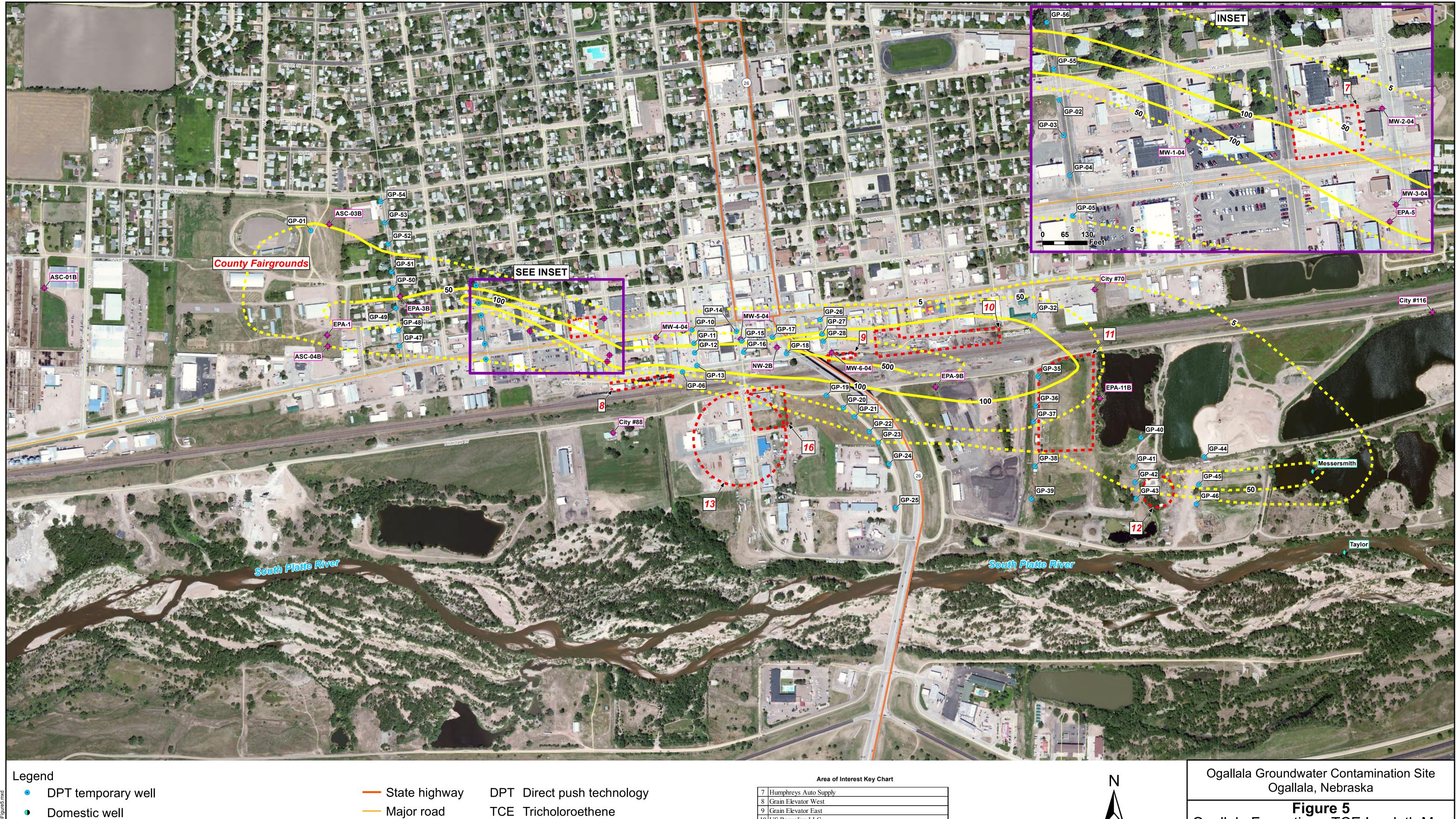




Drawn By: Gustavo Orozco

Project No: X9025.14.0002.01

Source: ESRI Data Maps, World Imagery, 2010; HSIP Gold, 2007



- Domestic well
- Monitoring well (screened in Ogallala Formation)
- Ogallala isopleth (inferred)
 - Ogallala isopleth (concentrations in micrograms per liter)

Street

Area of interest

Source: ESRI Data Maps, World Imagery, 2010; HSIP Gold, 2007

- TCE Tricholoroethene 9 Grain Elevator East
 - 10 US Recycling LLC
 - 11 Former Ogallala City Dump
 - 12 TCE Potential Spill Area
 - 13 Industrial Area at River and Spruce Streets 16 Good-All Electric

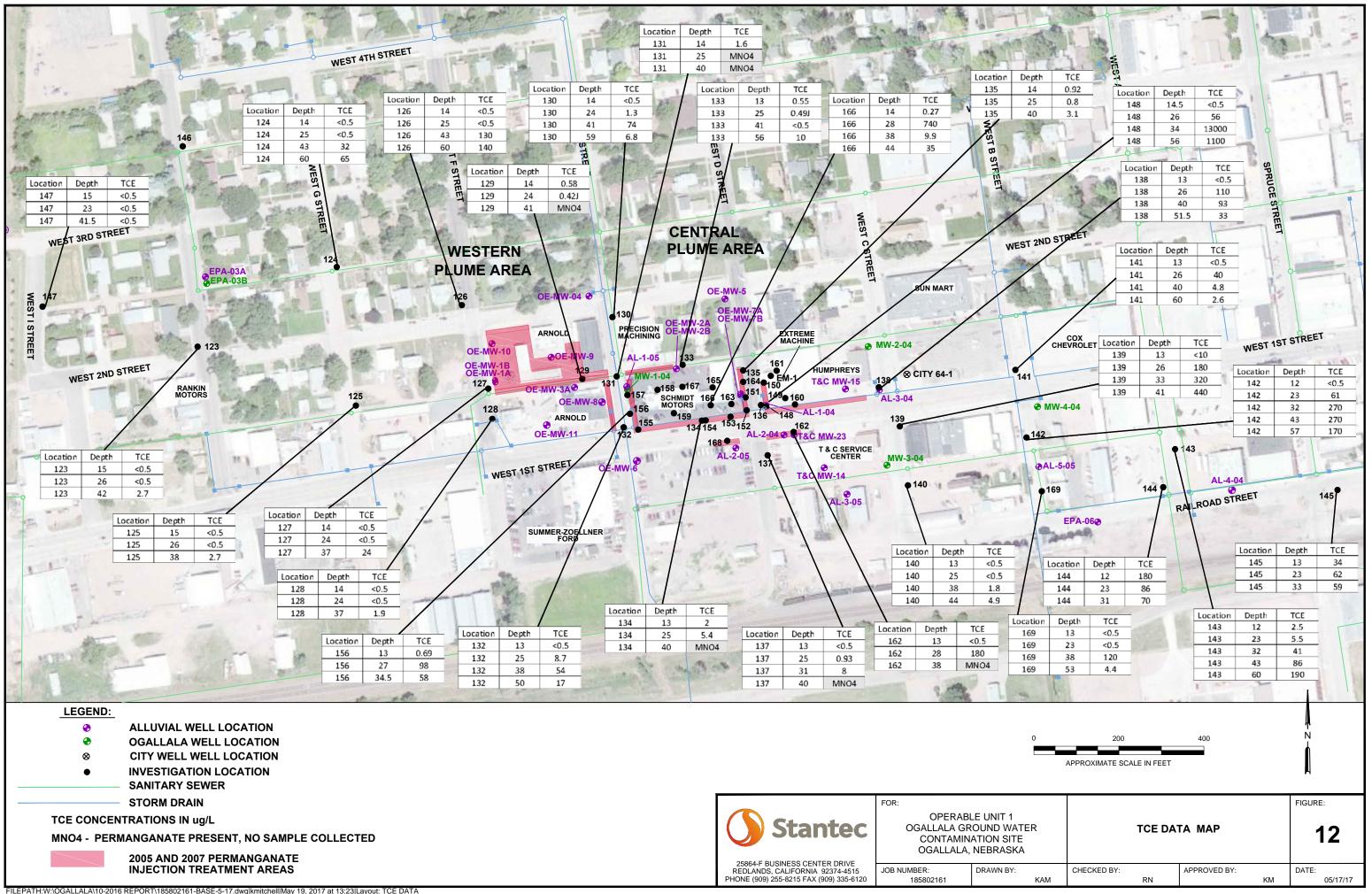
Feet

Figure 5
Ogallala Formation - TCE Isopleth Map (Monitoring Well Data Considered)



TETRA TECH

Drawn By: Gustavo Orozco Project No: X9025.14.0002.01



Appendix C

EPA Region 7 SOPs:

Groundwater Sample Collection,
Soil Gas Sample Collection,
Water level Measurement,
Sampling Equipment Decontamination,
Vapor Intrusion Port Installation, and
VOC Solids Collection

STANDARD OPERATING PROCEDURE

NO. 2313.4A

FOR AIR SAMPLING WITH STAINLESS STEEL CANISTER

September 28, 1989

by

Anil Roychowdhury, Ph.D.

APPROVED:										
Chief, Emer	gency Planning	Date								
Chief, Envir	ronmental Mon	Date								
Chief, Labo	ratory Branch	Date								
Regional Qu	uality Assuranc	Date								
Recertified:										
Branch	EMWC	EMWC								
Date	1/25/93	2/1/00								

SOP No. 2313.4A Page 2 of 8

A. <u>PURPOSE</u>

The purpose of this standard operating procedure (SOP) is to establish a uniform procedure for the collection of whole air samples using Summa polished stainless steel (S.S.) Canisters by various techniques, used mainly by the Environmental Services Division (ENSV).

B. APPLICATION

B.1 The air sampling procedure for volatile organic compounds (VOCs) using S.S. canisters shall be used by all ENSV staff members and may also be used by other EPA Region 7 employees, state or local agencies and their contractors.

C. REFERENCES

- C.1 The sampling will be performed with a clean evacuated S.S. canister. Prior to sample collection the canisters will be cleaned and evacuated to <20 millitorr as per SOP No. MA551A. (A. Roychowdhury, U.S. EPA Region 7, SOP No. MA551A: "Cleaning Stainless Steel Canisters," U.S. EPA, Kansas City, KS, June 21, 1989).
- C.2 At the end of sampling, a sample field sheet will be completed and chain of custody will be maintained as per SOP No. DK020A to document custody transfer of the sample. (D.I. Bates, U.S. EPA Region 7, SOP No. DK020A: "Field Chain of Custody for Environmental Samples," May 10, 1989.)

D. SAMPLING PROCEDURE

- D.1 The S.S. canisters offer flexibility when used to collect air samples. There are three primary modes of use. These include: 1) grab sampling of whole air samples; 2) short term time integrated samples; and 3) long term time integrated samples. Procedures for each are discussed as follows. The Summa polished S.S. canisters are cleaned and evacuated to 0.05 mmHg or approximately 0-20 millitorr according to the canister cleaning SOP reverenced earlier. For grab sampling of whole air samples, the upper valve is closed after sampling. Since there are no system elements unstream of the canister with which the sampled air may come into contact, this type of air sampling minimizes the possibility of contamination or sampling artifact carryover. It can be used in almost any environmental condition. However, sampling of particulates and dense smoky atmospheres should be avoided. Figure 1 (Attachment A) shows the schematic diagram of the grab sampling system using S.S. Canister.
- D.2 The second method for whole air sampling uses a mechanical variable flow controller (Veriflo Model #SC-423SXFT-B stainless steel version from Scientific Instrumentation Specialists, Moscow, Idaho) attached to the canister sample intake line (upper valve). The low pressure side of the flow controller must be toward the canister. The connections are made using 1/4 inch swagelok fittings. The air flow controllers will be calibrated using a bubble meter. A

SOP No. 2313.4A Page 3 of 8

pressure/vacuum gauge (Matheson Model #63-3704A or equivalent) may be attached to the lower valve of the canister. Alternatively, the pressure gauge and the flow controller are connected together by a swagelok "T" which is attached to the canister. The flow controller and the gauge assembly must be cleaned by heating the whole assembly in the oven at 80° C for 2 hours. The sampling is started by observing and recording the internal vacuum, then removing the flow controller swagelok nut and opening the upper valve of the canister. Sample start time should be recorded. At the end of the sampling, the upper valve of the canister will be closed, and the pressure gauge reading and stop time will be recorded. When using a flow controller, a constant flow rate is maintained so long as 10 psi differential is maintained across the controller. In order to analyze the sample without dilution, a minimum of -10 in. Hg Gauge (i.e., approximately 0.7 atmosphere) of air sample will be needed. For example, in order to obtain a -10 in Hg gauge reading at the end of a sampling period, it would require a sampling using method D.2. Figure 2 (Attachment B) shows the schematic diagram of air sampling system with flow controller using S.S. canister.

D.3 The third method of air sampling will be required when longer-term time integrated samples or higher volume samples are required. In this case, a mechanical flow controller and a fixed volume metering pump such as Scientific Instrumentation Specialists, Inc. with viton diaphragm (Model No. N-05 SVI, 12Volts DC) are used. The pump will be powered by a fully charged battery pack 12VDC, or can be operated on 6VDC. Extra battery packs may be added to provide long-term pump operation during cold weather condition. The flow control device requires a minimum pressure differential of 10 psig across the unit to maintain a constant flow rate. Because the pumps produce a head pressure of 38 psig, the canister can be pressurized to a maximum of approximately 28 psig while maintaining a constant flow rate. As an example, at 10 cc/min for 24 hours a total air sample volume of approximately 14.4 liters will be collected with an internal canister pressure of 17.6 psig at standard conditions. Figure 3 (Attachment C) is a schematic diagram of an air sampling system with flow controller and pump attached to the S.S. canister. The start and stop time of air sampling will be recorded. The upper valve of the canister will be closed at the end of sampling. Figure 4 (Attachment D) shows the diagram of a tripod assembly for holding the canister, flow controller and a shelter box for pump and batteries to be used during this type of air sampling.

E. DETERMINATION OF FLOW RATE

A flow control device is selected in order to maintain a constant air flow into the canister over a desired sampling time. This flow rate is determined prior to actual field sampling and the flow control device is calibrated using a soap film bubble meter. The flow rate should be calculated so as to fill the canister to about -10 inHg (approximately equal to 0.70 atmosphere absolute), using method D.2, and <28 psig using method D.3. The flow rate is calculated using the following formula:

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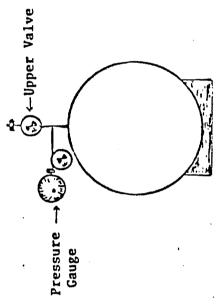
$$F = \frac{P \times V}{T \times 60}$$

where F = flow rate (cc/min)

P = final canister pressure, atmospheres, absolute V = volume of canister (cm 3)

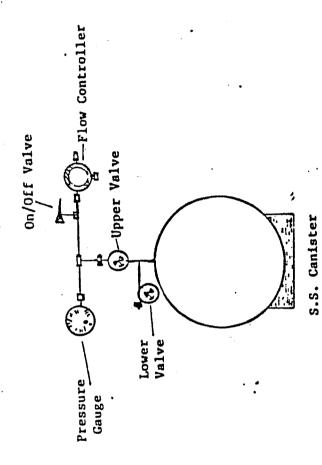
T = sample period (hour)

7, 27

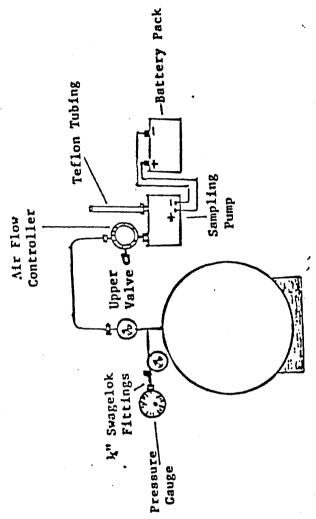


S.S. Canister

Schematic Diagram of Air Sampling System Using S.S. Canister



Schematic Diagram of Air Sampling System Using S.S. Canister



, ,

S.S. Canister

Schematic Diagram of Air Sampling System Using S.S. Canister

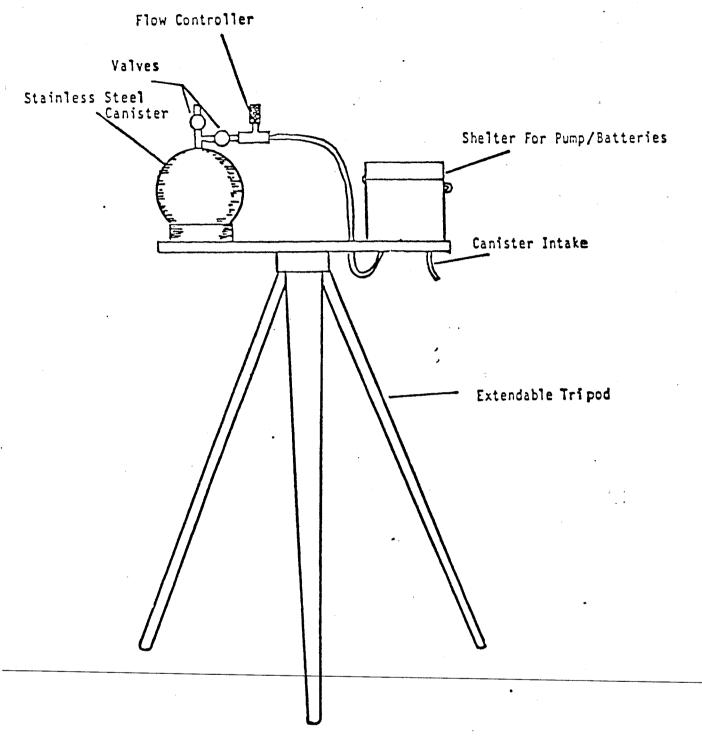


Diagram of Tripod Assembly for Air Sampling Using S.S. Canister



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SOIL GAS SAMPLING

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1.0	SCOPE AND APPLICATION*			
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3.0	SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE			
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4.0 INTERFE		FERENCES AND POTENTIAL PROBLEMS		
	4.1 4.2. 4.3 4.4 4.5	PID Measurements* FID Measurements* Factors Affecting the Concentrations of Organic Compounds in Soil Gas* Soil Probe Clogging* Underground Utilities		
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	5.1 5.2 5.3	Slam Bar Method Power Hammer Method Direct-Push (Geoprobe TM) Method		
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7.0	PROCEDURES			

7.1.1

7.1.2

7.1.3

Soil Gas Probe Installation*

Tedlar® Bag Sampling*

Slam Bar Method

Screening with Field Instruments*

Power Hammer Method

Direct-Push Method

7.1

7.2

7.3

^{*} These sections are affected by Revision 0.0



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SOIL GAS SAMPLING

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7.4	Sorbent Tube Sampling
	7.4.1 Additional Apparatus*
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 - 9.5.2 Sorbent Tubes
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 - 9.6.1 Tedlar® Bags
 - 9.6.2 Sorbent Tubes
- 9.7 Trip Standards
- 9.8 Lot Blanks*
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 - 9.8.2 Summa® Canister Check*
 - 9.8.3 Sorbent Tubes*
- 9.9 Options
 - 9.9.1 Duplicate Samples*
 - 9.9.2 Spikes

10.0 DATA VALIDATION

10.1 Blanks*

^{*} These sections are affected by Revision 0.0



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SOIL GAS SAMPLING

CONTENTS (Cont'd)

- 11.0 HEALTH AND SAFETY*
- 12.0 REFERENCES*
- 13.0 APPENDICES*
 - A. Figures
 - B. HNu® Field Procedure

SUPERCEDES: SOP #2042; Revision 0; 6/1/96; U.S. EPA Contract 68-C4-0022.

^{*} These sections are affected by Revision 0.0



SOP: 2042 PAGE: 4 of 22 REV: 0.0 DATE: 04/18/01

SOIL GAS SAMPLING

1.0 SCOPE AND APPLICATION

Soil gas monitoring provides a quick means of detecting volatile organic compounds (VOCs) in the soil subsurface. Using this method, underground VOC contamination can be identified, and the source, extent, and movement of pollutants can be traced.

This standard operating procedure (SOP) outlines the methods used for the installation of soil gas wells; the collection of soil gas using Tedlar® bags, sorbent tubes, and/or Summa canisters; and measurement of organic vapor levels in the soil gas using a Photo Ionization Detector (PID), Flame Ionization Detector (FID) and/or other air monitoring devices.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

A **d**-inch (")diameter hole is driven into the ground using manual (i.e., slam bar) or power driven mechanical (i.e., Geoprobe) methods. Soil gas can be sampled at specific depths by controlled penetration and/or the use of a longer bar or bar attachments. A ¼"outer diameter (O.D.) stainless steel probe is inserted into the hole. The hole is sealed around the top of the probe using clean modeling clay. The gas contained in the interstitial spaces of the soil is pulled through the probe using an air sampling pump. The sample may be stored in Tedlar® bags, drawn through sorbent cartridges, or analyzed directly using a field portable instrument such as a PID. An air sampling pump is not used for Summa® canister sampling of soil gas; sampling is achieved by soil gas equilibration with the evacuated Summa® canister.

Power driven mechanical devices may be used to make holes when conditions make the use of manual devices unfeasible (i.e., frozen ground, very dense clays, pavement, etc.). Commercially available soil gas sampling probes (hollow, ½" O.D. steel probes) can be driven to the desired depth using a power hammer (e.g., demolition hammer or GeoprobeTM). Soil gas samples can be drawn through the probe itself, or through Teflon tubing inserted through the probe and attached to the probe point. Samples are collected and analyzed as described below.

Other field air monitoring devices, such as the Combustible Gas Indicator (CGI) and the Organic Vapor Analyzer (OVA), can also be used, depending on specific site conditions. Measurement of soil temperature using a temperature probe may also be desirable. Bagged samples may be analyzed in a field laboratory using portable gas chromatography (GC) instrumentation, or shipped to a laboratory using an overnight service.



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3.1 Tedlar® Bags

Soil gas samples are generally collected in 1.0-liter (L) Tedlar® bags. Bagged samples should be stored in the dark (i.e., in opaque containers) and protected from mechanical damage during transit to the laboratory. Further, bagged samples should be maintained at ambient temperature by placing them in coolers and out of direct sunlight. Samples should be analyzed as soon as possible, preferably within 24 to 48 hours following sample collection. Refer to ERT/REAC SOP# 2102, *Tedlar*® *Bag Sampling*, for additional information.

3.2 Sorbent Tubes

Soil gas can be drawn directly onto sorbent tubes (i.e., Tenax tubes) and analyzed by Gas Chromatography/Mass Spectrometer (GC/MS) methodologies. Bagged samples can also be drawn onto tubes. If sorbent tubes are to be used, special care must be taken to avoid contamination. Refer to ERT/REAC SOP# 2104, *Tenax/CMS Tube Sampling*, for additional information. Samples should be refrigerated at 4 °C during storage and analyzed within 30 days of collection. Samples taken on multi-sorbent tubes should be analyzed as soon as possible after sampling.

3.3 Summa® Canisters

The Summa® canisters used for soil gas sampling have a 6-L sample capacity and are certified clean by GC/MS analysis before being used in the field. After sampling is completed, they are stored and shipped in travel cases. Most volatile organic compounds (VOCs) can be recovered from canisters with minimal loss up to thirty days. Refer to ERT/REAC SOP# 1704, Summa Canister Sampling, for additional information.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 PID Measurements

A number of factors specific to soil gas can affect the response of a PID (e.g., HNu® PI 101). High humidity can cause lamp fogging and decreased sensitivity. This can occur when soil moisture levels are high, or when a soil gas probe is in the saturated zone. High concentrations of methane can cause a downscale deflection of the meter. High and low temperature, electrical fields, FM radio transmission, and naturally occurring compounds, such as terpene hydrocarbons in wooded areas, will affect instrument response. Refer to ERT/REAC SOP# 2114, *Photoionization Detector (PID) HNu*® for additional information.

4.2 FID Measurements

A number of factors specific to soil gas can affect the response of an FID (e.g., OVA Model 128). High humidity can cause the FID to flame out or not ignite at all. This can be significant when soil moisture levels are high, or when a soil gas probe is in the saturated zone. The FID can only read organic based



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compounds (they must contain carbon in the molecular structure). The FID also responds poorly to hydrocarbons and halogenated hydrocarbons (such as gasoline, propane fuel). High and low temperature, electrical fields and FM radio transmission will also affect instrument response. Consult the instrument manual for additional information.

4.3 Factors Affecting the Concentrations of Organic Compounds in Soil Gas

Concentrations of organic compounds in soil gas can be affected by the physical and chemical characteristics of the soil and by soil moisture. Organic molecules can be tightly adsorbed to the surface of chemically active soil particles, such as clays, thus reducing the concentration in the soil interstitial spaces. Similarly, some organic compounds can be dissolved in the soil water or associated with soil organic components (i.e., humic acids).

Soil porosity and permeability will affect the movement of soil gas and the recharge rate of the soil gas well. The movement of organic vapors through fine textured soil may be very slow, thus limiting the sample volume available and the use of this technique. Existing information and soil surveys prepared by the Soil Conservation Service should be consulted prior to planning and designing a soil gas survey.

The presence of a high, or perched water table, or of an impermeable underlying layer (such as a clay lens or layer of buried slag) may interfere with the movement and sampling of the soil gas. Knowledge of site geology is useful in such situations, and can prevent inaccurate sampling.

4.4 Soil Probe Clogging

A common problem with the soil gas sampling is clogging of the probe. A clogged probe can be identified by using an in-line vacuum gauge or by listening for the sound of the pump laboring. This problem can usually be eliminated by using a wire cable to clear the probe (see Section 7.1.3.).

4.5 Underground Utilities

Prior to selecting sample locations, an underground utility search must be completed. The local utility companies can be contacted and requested to mark the locations of their underground lines. Each sample location should also be screened with a metal detector or magnetometer to verify that no underground metallic or ferro-magnetic pipes or drums are present.

5.0 EQUIPMENT/APPARATUS

5.1 Slam Bar Method

- C Slam bar
- C Soil gas probes: stainless steel tubing, 1/4" O.D., 5-foot (ft) length
- C Flexible wire or cable



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C	"Quick Connec	ct" fittings
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- C Modeling clay.
- C Vacuum box
- C Pumps, capable of drawing approximately 3.0 L/min
- C ¼" Teflon® tubing, 2-ft to 3-ft lengths
- C ¼" Tygon tubing
- C Tedlar® bags, 1.0-L
- C Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- C PID/FID, or other field air monitoring devices
- Cooler(s)
- C Metal detector or magnetometer
- C Portable GC instrument
- C Summa® canisters (plus shipping cases)
- C Large dark plastic bags

5.2 Power Hammer Method

- C Power (Demolition) hammer
- C ½" O.D. steel probes, extensions, and points
- C Dedicated aluminum sampling points
- C 4" Teflon® tubing, 2-ft to 3-ft lengths
- C "Quick Connect" fittings
- C Modeling clay.
- C Vacuum box
- C Pumps, capable of drawing approximately 3.0 L/min
- C 1/4" Tygon tubing
- C Tedlar® bags, 1.0-L
- C Sample documentation (soil gas sample labels, field data sheets, logbook, etc.)
- C PID/FID or other field air monitoring devices
- Cooler(s)
- C Metal detector or magnetometer
- C Portable GC instrument
- C Summa® canisters (plus shipping cases)
- C Generator w/extension cords.
- C High lift jack assembly
- Large dark plastic bags

5.3 Direct-Push (GeoprobeTM) Method

- Tubing; polyethylene, Teflon®, or stainless steel
- Gas sampling cap
- Probe rods
- Tubing adaptor(s)



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- Expendable point holder, threaded
- Expendable drive point(s)
- O-rings for expendable point holder
- O-rings for adaptor
- O-rings for probe rods
- O-rings for gas sampling cap
- Vacuum pumps
- Tape
- Tedlar® bags, 1.0-L
- Summa® canisters (plus shipping cases)
- Sample documentation (soil gas labels, field data sheets, logbook, etc.)
- Metal detector or magnetometer
- Cooler(s)
- Large dark plastic bags
- Portable GC instrument

6.0 REAGENTS

- Calibration and spike gases
- C Deionized, organic-free water
- C Methanol, High Performance Liquid Chromatography (HPLC) grade
- C Ultra-zero grade compressed air
- C Propane torch

7.0 PROCEDURES

7.1 Soil Gas Probe Installation

7.1.1 Slam Bar Method

- 1. A hole slightly deeper than the desired sampling depth is made. For sampling up to 5 feet, a 5-ft single piston slam bar is used. For deeper depths, a piston slam bar with threaded 4-ft-long extensions is used.
- 2. The tip of the rod is placed on the ground and the piston of the slam bar is used to drive the rod to the desired depth. The number of blows required to reach the desired depth is recorded.
- 3. After the hole is made, the slam bar is carefully withdrawn to prevent the collapse of the walls.
- 4. The soil gas probe is carefully inserted into the hole. To prevent plugging of the probe, a decontaminated metal wire or cable, slightly longer than the probe and with



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an O.D. slightly less than the inner diameter (I.D.) of the rod, is inserted in the probe rod; 1- to 2-inches of wire should protrude from the end of the probe. The probe is inserted to full depth of the hole, then pulled up three to six inches. The probe is cleared by moving the cable up and down several times.

- 5. The top of the sample hole is sealed at the surface to prevent infiltration of ambient air. A golf-ball size lump of clean modeling clay is kneaded until it becomes soft. The clay is carefully molded around the probe at the soil surface to seal the space between the probe and the hole.
- 6. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.1.2 Power Hammer Method

- 1. A power hammer may be used to make holes when the soil is very hard, frozen or fine textured (clay), or when soil gas from beneath pavement or concrete is collected.
- 2. A power hammer is used to drive the probe to the desired depth (up to 12 feet may be attained with extensions). Threaded extensions are added until the desire depth is needed.
- 3. After the hole is made, the threaded rod is carefully withdrawn. This should be done in such a manner to prevent collapse of the walls. If necessary, a jack assembly may be used to retrieve the rods.
- 4. The soil gas probe is installed in the hole as described in Section 7.1.1, Steps 4 and 5
- 5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.1.3 Direct-Push Method

- Direct-push sampling technology refers to soil gas samplers that are inserted into
 the ground without the use of slam bars, demolition hammers, or drilling rigs. The
 U.S. EPA/ERT utilizes a Direct-Push unit mounted on an all-terrain track mounted
 vehicle, and direct push tools. These tools are able to collect samples at depths
 greater than 50 feet, depending on soil conditions.
- 2. Sampling probes, consisting of 3-foot sections of flush-threaded, 1¼-inch hardened steel alloy steel rod tipped by an expendable steel point, are driven into the groung



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to the target depth. The probe tools are withdrawn to release the expendable tip and allow soil gas to flow into the tool's tubing.

- 3. To ensure a representative soil gas sample, a discrete volume of gas is purged to rid the tubing of atmospheric air and allow the subsurface soil gas to enter the probe tubing. The volume of gas removed is determined by the volume of tubing employed in the probe. (Unlike groundwater sampling, purging of a soil gas probe is designed to remove only the ambient air within the tubing.)
- 4. After allowing the system to return to atmospheric pressure, an aliquot of soil gas is withdrawn from the probe. Duplicate samples are collected as necessary and required.
- 5. If semi-permanent soil gas installations are required, the probe remains in the hole, which may be sealed by backfilling with clean sand, soil, or bentonite.

7.2 Screening with Field Instruments

- 1. It is recommended that any appropriate SOPs and the manufacturers' manuals be consulted for the correct use and calibration of all instrumentation. Pumps should be calibrated prior to use in the field.
- 2. An amount of air, equivalent to the volume of the soil gas well <u>must</u> be calculated prior to sampling. Connect a vacuum pump to the sample probe using a section of Teflon® tubing. The pump is turned on and adjusted to a flow rate of 3.0 L/minute. The calculated volume of air is evacuated from the hole by pulling a vacuum through the probe for the specified length of time. Longer time is required for sample wells of greater depths.
- 3. After evacuation, a monitoring instrument (i.e. HNu® or OVA) is connected to the probe using a Teflon connector. Upon stabilization, the reading is recorded on soil gas data sheets.
- 4. Readings may be above or below the range set on the field instruments. The range may be reset, or the response recorded as a greater than or less than figure. The recharge rate of the well with soil gas must be considered when resampling at a different range setting.

7.3 Tedlar® Bag Sampling

- 1. Follow step 1 of section 7.2 to evacuate well volume. If air monitoring instrument screening was performed prior to sample collection, evacuation is not necessary.
- 2. Use the vacuum box and sampling train (Figure 1) to collect the sample. The sampling train is designed to minimize the introduction or loss of contaminants due to adsorption and other factors. All parts used are either Teflon® or stainless steel, and a vacuum is drawn indirectly



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to avoid contamination from sample pumps.

- 3. Place the Tedlar® bag inside the vacuum box, attach it to the sampling port and open the valve. The sample probe is attached to the sampling port via Teflon® tubing and a "Quick Connect" fitting.
- 4. Draw a vacuum around the outside of the bag, using a pump connected to the vacuum box evacuation port, via Tygon tubing and a "Quick Connect" fitting. The negative pressure inside the box causes the bag to inflate, drawing the sample into the bag.
- 5. Break the vacuum by removing the Tygon line from the pump. Remove the bagged sample from the box and close the valve. Record the date, time, sample location ID, and the PID/FID instrument reading(s) on sample bag label and on data sheets or in logbooks.

Bags should not be labeled directly with a marker or pen (particularly those containing volatile solvents) or should adhesive labels be affixed directly to the bags. Inks and adhesive may diffuse through the bag material and contaminate the sample. Labels should be tied to the metal eyelets provided on the bags.

Chain of custody sheets must accompany all samples.

7.4 Sorbent Tube Sampling

Samples collected in Tedlar® bags may be adsorbed onto sorbent tubes for further analysis by GC/MS.

7.4.1 Additional Apparatus

- Syringe, with a luer-lock tip, capable of drawing a soil gas or air sample from a Tedlar® bag onto a sorbent tube. The syringe capacity is dependent upon the volume of sample being drawn onto the tube.
- Adapters, for fitting the sorbent tube between the Tedlar® bag and the sampling syringe. The adapter attaching the Tedlar® bag to the sorbent tube consists of a reducing union (¼" to1/16" O.D. Swagelok cat. #SS-400-6-ILV or equivalent) and a length of ¼" O.D. Teflon® tubing, which replaces the nut on the 1/16" (Tedlar® bag) side. A ¼" I.D. Teflon® or silicone O-ring replaces the ferrules in the nut on the ¼" (sorbent tube) side of the union.

The adapter, attaching the sampling syringe to the sorbent tube, consists of a reducing union (¼" to 1/16" O.D. - Swagelok Cat. #SS-400-6-ILV or equivalent) and a ¼" I.D. Teflon® or silicone O-ring, which replaces the ferrules in the nut on the ¼" (sorbent tube) side and the needle of a luer-lock syringe inserted into the 1/16"



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side (held in place with a 1/16" ferrule). The luer-lock end of the needle can be attached to the sampling syringe. It is useful to have a luer-lock on/off valve situated between the syringe and the needle.

- Two-stage glass sampling cartridge (¼" O.D. x C" I.D. x 5C") contained in a flame-sealed tube containing two sorbent sections retained by glass wool:
- Teflon-capped culture tubes or stainless steel tube containers for sorbent tube storage and shipping. These containers should be conditioned by baking at 120° C for at least two hours. The culture tubes should contain a glass wool plug to prevent sorbent tube breakage during transport. Reconditioning of the containers should occur between uses or after extended periods of disuse (i.e., two weeks or more).
- Nylon gloves or lint-free cloth. (Hewlett Packard Part # 8650-0030 or equivalent.)
 7.4.2 Sample Collection
 - Handle sorbent tubes with care, using nylon gloves (or other lint-free material) to avoid contamination.
 - Immediately before sampling, break one end of the sealed tube and remove the sorbent cartridge.
 - Connect the valve on the Tedlar® bag to the sorbent tube adapter. If using a Tenax/CMS sorbent tube, connect the sorbent tube to the sorbent tube adapter with the Tenax (white granular) side of the tube facing the Tedlar® bag. Connect the sampling syringe assembly to the carbon molecular sieve [CMS (black)] side of the sorbent tube. Fittings on the adapters should be finger-tight. Open the valve on the Tedlar® bag. Open the on/off valve of the sampling syringe. Depending on work plan stipulations, at least 10% of the soil gas samples analyzed by field screening methods must be submitted for confirmation GC/MS analysis (according to a modified TO-17method for sorbent tubes). Each soil gas sample must be absorbed on replicate sorbent tubes. The volume adsorbed on a sorbent tube is dependent on the total concentration of the compounds measured by field screening methods as follows:

Total Concentration (ppm)	Sample Volume (mL)	
>10	Use Serial Dilution	
10	10-50	
5	20-100	
1	100-250	

After sampling, remove the tube from the sampling train with gloves or a clean



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cloth. DO NOT LABEL OR WRITE ON THE SORBENT TUBE.

- Place the sorbent tube in a conditioned stainless steel tube holder or culture tube. Culture tube caps should be sealed with Teflon tape.
- Each sample tube container (not tube) must be labeled with the site name, sample number, date sampled, and volume sampled. Verify that all sample containers are properly labeled.
- Chain of custody sheets must accompany all samples to the laboratory.

7.5 Summa® Canister Sampling

- 1. Follow Section 7.2, step 1, to evacuate well volume. If PID/FID readings were taken prior to taking a sample, evacuation is not necessary.
- 2. Attach a certified clean, evacuated 6-L Summa® canister via the ¼" Teflon tubing.
- 3. Open valve on Summa® canister. The soil gas sample is drawn into the canister by pressure equilibration. The approximate sampling time for a 6-L canister is 20 minutes.
- 4. Sample number, sample location, date collected and work assignment number must be recorded on a chain of custody form and on a blank tag attached to the canister.
- 5. Chain of custody sheets must accompany all samples to the laboratory.

8.0 CALCULATIONS

8.1 Field Screening Instruments

Instrument readings are usually read directly from the meter. In some cases, the background level at the soil gas location may be subtracted:

Final Reading = Sample Reading - Background Reading

8.2 Field Portable GC Analysis

Calculations used to determine concentrations of individual components by field portable GC analysis are beyond the scope of this SOP and are covered ERT/REAC SOP #2109, *Photovac GC Analysis for Soil. Water and Air/Soil Gas.*



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9.1 Sample Sorbent Tubes

Before field use, a quality assurance (QA) check must be performed on each batch of sorbent tubes by thermal desorption/cryogenic trapping GC/MS. These tubes are prepared and cleaned in accordance with EPA Method EMSL/RTP-SOP-EMD-013 by the vendor. Prior to purchasing a lot of tubes from a vendor, ten tubes from the lot are sent to the REAC laboratory where the tubes are tested for cleanliness, precision and reproducibility.

Sample tubes should be stored out of ultraviolet (UV) light (i.e., sunlight) and kept on ice until analysis. Samples should be collected in duplicate, whenever possible.

9.2 Sample Probe Contamination

Sample probe contamination is checked between each sample by drawing ambient air through the probe using a vacuum pump (e.g., Gilian pump) and checking the response of the FID/PID. If readings are higher than background, replacement or decontamination is necessary.

Sample probes may be decontaminated simply by drawing ambient air through the probe until the HNu® reading is at background. Contamination can also be removed by decontaminating with methanol and deionized water, then air drying. For persistent contamination, use of a portable propane torch may be needed. Using a pair of pliers to hold the probe, run the torch up and down the length of the sample probe for approximately 1-2 minutes. Let the probe cool before handling. When using this method, make sure to wear gloves to prevent burns. Having more than one probe per sample team will reduce lag times between sample stations while probes are decontaminated.

9.3 Sample Train Contamination

The Teflon® line forming the sample train from the probe to the Tedlar® bag should be changed on a daily basis. If visible contamination (soil or water) is drawn into the sampling train, it must be changed immediately. When sampling in highly contaminated areas, the sampling train should be purged with ambient air, via a vacuum pump (e.g, Gilian pump), for approximately 30 seconds between each sample. After purging, the sampling train can be checked using an FID or PID, or other field monitoring device, to establish the cleanliness of the Teflon® line.

9.4 FID/PID Calibration

The FID and PID must be calibrated at least once a day using the appropriate calibration gases.

9.5 Trip Blanks

A trip blank detects any sample contamination during shipping and storage. With the exception of Summa® canisters, the trip blank is prepared and added to the site samples after sampling has been completed and prior to shipment.



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9.5.1 Tedlar® Bags

Each cooler containing Tedlar®bag samples must contain one Tedlar® bag of ultra-zero grade air, acting as a trip blank, when samples are shipped to an outside laboratory. A chain of custody record must accompany each cooler of samples and should include the blank that is dedicated to that group of samples.

9.5.2 Sorbent Tubes

At least one trip blank per cooler must be submitted with the sorbent tube samples. The ends of the sorbent tube are broken but no air is drawn through the tube.

9.5.3 Summa® Canisters

Canister trip blanks are evacuated containers that are shipped to and from the site with the canisters used for air sampling.

9.6 Field Blanks

A field blank detects sample contamination during the handling and shipping process. The field blank must be associated with an actual sampling event.

9.6.1 Tedlar® Bags

For each day of sampling, a Tedlar® bag is filled with ultra-zero air at the beginning of the day. The field blank is handled in the same manner as the samples.

9.6.2 Sorbent Tubes

For each day of sampling, a field blank must be submitted for sorbent tubes. The ends of the sorbent tube are broken at the beginning of the day but no air is drawn through the tube.

9.7 Trip Standards

If Tedlar® bags are used for sampling, each cooler containing samples should contain a Tedlar® bag of standard gas to calibrate the analytical instruments (Photovac GC, etc.). This trip standard will be used to determine any changes in concentrations of the target compounds during the course of the sampling day (e.g., migration through the sample bag, degradation, or adsorption). A fresh trip standard must be provided and placed in each cooler pending additional sample collection. A chain of custody record must accompany each cooler of samples and should include the trip standard that is dedicated to that group of samples.



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9.8.1 Tedlar® Bags

Prior to use, one bag is removed from each lot of Tedlar® bags to be used for sampling and checked for possible contamination as follows: Fill the test bag with ultra-zero grade air; withdraw a sample from the bag and analyze using a field portable GC or any other applicable field instrument used for sample analysis. This procedure will ensure sample container cleanliness prior to the start of the sampling effort.

9.8.2 Summa® Canister Check

From each lot of four cleaned Summa® canisters, one is used for a GC/MS certification check. If the canister passes certification, it is re-evacuated and all four canisters from that lot are available for sampling. If the chosen canister is contaminated, the entire lot of four Summa® canisters must be re-cleaned, and a single canister is re-analyzed by GC/MS for certification.

9.8.3 Sorbent Tubes

Provide a minimum of one sorbent tube per sampling event. Do not break the ends of the tube.

9.9 Options

9.9.1 Duplicate Samples

A minimum of 5% of all samples should be collected in duplicate (i.e., if a total of 100 samples are to be collected, five samples should be collected in duplicate). In choosing which samples to duplicate, the following criteria applies: if, after filling the first Tedlar® bag and evacuating the well for 15 seconds, the second HNu® reading (or other field monitoring device being used) matches or is close to (within 20%) the first reading, a duplicate sample may be taken.

9.9.2 Spikes

A Tedlar® bag spike and sorbent tube spike may be desirable in situations where high concentrations of contaminants other than the target compounds are found to exist (landfills, etc.). The additional level of QA/QC attained by this practice can be useful in determining the effects of interferences caused by these non-target compounds. Summa canisters containing samples are not spiked.

10.0 DATA VALIDATION



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For each target compound, the concentration found in the sample must be greater than three times the level (for that compound) found in the appropriate blank (lot, field, trip) that accompanied that sample, to be considered valid.

11.0 HEALTH AND SAFETY

Because the sample is being drawn from underground, and no contamination is introduced into the breathing zone, soil gas sampling usually occurs in Level D. Nevertheless, ambient air should be constantly monitored using the HNu® P101 to obtain background and breathing zone readings during the sampling procedure. As long as the levels in ambient air do not rise above background, no upgrade of the level of protection is needed.

When conducting soil gas sampling, appropriate personal protective equipment [PPE (leather gloves, steel-toed shoes, Tyvek® safety suit)] should be worn, and proper slam bar techniques should be implemented Also, an underground utility search must be performed prior to sampling (See Section 4.5).

12.0 REFERENCES

Gilian Instrument Corp. 1983. Instruction Manual for Hi Flow Sampler: HFS113, HFS 113 T, HFS 113U, HFS 113 UT.

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13.0 APPENDICES

- A Figures
- B HNu® Field Procedure



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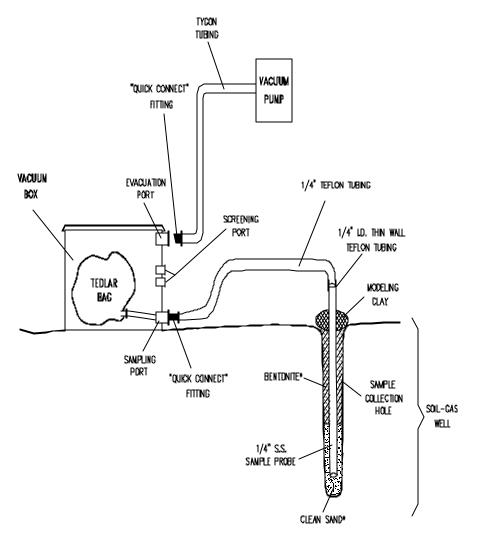
APPENDIX A
Figure
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FIGURE 1. Sampling Train Schematic



^{*} USED ONLY FOR SEMPERMANENT INSTALLATIONS



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APPENDIX B HNu® Field Procedure SOP # 2042 April 2001



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HNu® Field Procedure

The following sections detail the procedures that are to be followed when using the HNu® in the field.

Startup Procedure

- a. Before attaching the probe, check the function switch on the control panel to ensure that it is in the off position. Attach the probe by plugging it into the interface on the top of the readout module. Use care in aligning the prongs in the probe cord with the plug in; don't force the probe cord.
- b. Turn the function switch to the battery check position. The needle on the meter should read within or above the green battery area on the scale. If not, recharge the battery. If the red indicator light comes on, the battery needs recharging.
- c. Turn the function switch to any range setting. Look into the end of the probe for no more than two to three seconds to see if the lamp is on. If it is on, it will give a purple glow. Do not stare into the probe any longer than three seconds. Long term exposure to UV light can damage eyes. Also, listen for the hum of the fan motor.
- d. To ZERO the instrument, turn the function switch to the standby position and rotate the zero adjustment until the meter reads zero. A calibration gas is not needed for this instrument. If the span adjustment setting is changed after the zero is set, the zero should be rechecked and adjusted, if necessary. Wait 15 to 20 seconds to ensure that the zero reading is stable. If necessary, readjust the instrument to zero.

Operational Check

- a. Follow the start-up procedure.
- b. With the instrument set on the 0-20 ppm range, hold a solvent-based magic marker near the probe tip. If the meter deflects upscale, the instrument is working.

Field Calibration Procedure

- a. Follow the start-up procedure and the operational check.
- b. Set the function switch to the range setting for the concentration of the calibration gas.
- c. Attach a regulator to a disposable cylinder of isobutylene gas. Connect the regulator to the probe of the HNu® with a piece of clean Tygon tubing. Turn on the regulator valve.
- d. After fifteen seconds, adjust the span dial until the meter reading equals the concentration of the calibration gas used. Be careful to unlock the span dial before adjusting it. If the span has to be set below 3.0, calibrate the instrument internally or return to equipment maintenance for repair.



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e. Record in the field logbook: the instrument ID no. (EPA decal or serial number if the instrument is a rental); the initial and final span settings; the date and time; concentration and type of calibration gas used; and the name of the person who calibrated the instrument.

Operation

- a. Follow the start-up procedure, operational check, and calibration check.
- b. Set the function switch to the appropriate range. If the concentration of gases or vapors is unknown, set the function switch to the 0-20 ppm range. Adjust it if necessary.
- c. While taking care not to permit the HNu® to be exposed to excessive moisture, dirt, or contamination, monitor the work activity as specified in the site specific Health and Safety Plan.
- d. When the activity is completed or at the end of the day, carefully clean the outside of the HNu® with a damp disposable towel to remove any visible dirt. Return the HNu® to a secure area and place on charge.
- e. With the exception of the probe's inlet and exhaust, the HNu® can be wrapped in clear plastic to prevent it from becoming contaminated and to prevent water from getting inside in the event of precipitation.



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Non-Contact Gas Bladder Pumps*

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^{*} These sections affected by Revision 0.0.



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1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) provides general information on sampling groundwater wells and ensures that the sample is representative of the particular groundwater zone being sampled. The growing concern over the past several years with respect to low levels of volatile organic compounds (VOCs) in water supplies has led to the development of highly sophisticated analytical methods that can provide detection limits at part per trillion levels. While the laboratory methods are extremely sensitive, well controlled and quality assured, they cannot compensate for a poorly collected sample. The collection of a sample should be as sensitive, highly developed and quality assured as the analytical procedures.

The procedures are designed for sampling the most common types of groundwater contaminants (e.g., volatile and semivolatile organic compounds, pesticides, herbicides, polychlorinated biphenyls (PCBs), metals, and biological parameters).

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, or equipment limitations and limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

In order to obtain a representative groundwater sample for chemical analysis (es), it is important to remove stagnant water from the well casing and the water immediately adjacent to the well before collection of the sample. This may be achieved with one of a number of sampling devices. The most common of these devices are the bailer, submersible pump, non-contact gas bladder pump, inertia pump and suction pump. At a minimum, three well volumes should be purged, if possible. Equipment must be decontaminated prior to use and between wells. Once purging is completed and the proper sample containers have been prepared, sampling may proceed. Samples should be collected from the depth interval where contaminants are expected but need not be collected with the same device used for well purging. However, some sampling methods will affect sample integrity and care should be taken when choosing the sampling device. If possible, sampling should occur progressively from the least to the most contaminated well.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The sample analysis determines the type of bottle, preservative, holding time, and filtering requirements. Samples should be collected directly from the sampling device into appropriate sample containers. Check that a Teflon liner is present in the cap of the sample container, if required. Attach a sample identification label. Complete a field data sheet, a chain of custody form, and record all pertinent data in the site logbook.



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Samples should be placed in a cooler and maintained at 4EC and ideally should be shipped within 24 hours of sample collection. If large numbers of samples are being collected, shipments may occur on a regular basis after consultation with the analytical laboratory. In all cases, samples should be shipped well before the holding time expires.

Due to the trace levels at which volatile organics are detectable, cross contamination and introduction of contaminants must be avoided. Treatment of the sample with sodium thiosulfate preservative is required only if there is residual chlorine in the water that could cause free radical chlorination and change the identity of the original contaminants. This preservative should not be used if there is no chlorine in the water. Quality assurance/quality control (QA/QC) samples are incorporated into the shipment package to provide a check against cross contamination. Samples for the analysis of volatiles, semivolatiles, pesticides, herbicides and PCBs do not normally require preservation. Groundwater samples for metal analyses should be adjusted with nitric acid to a pH of less than 2. Refer to REAC SOP# 2003, Sample Storage, Preservation and Handling.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The primary goal of well sampling is to obtain a representative sample of the groundwater. Analysis can be compromised by: (1) taking an unrepresentative sample, or (2) by incorrect handling of the sample. To avoid introducing foreign contaminants into a sample, strict sampling procedures should be followed.

4.1 Well Purging

In a non-pumping well, there will be little or no vertical mixing of the water, and stratification will occur. The well water above the screened section will remain isolated and may lack the contaminants representative of the ground water. To avoid collecting unrepresentative water, all monitor wells should be purged of three to five volumes of water prior to sampling. When purging with a submersible pump, the pump intake may be set within the screened interval if evaluation of the well construction, pumping rate, and aquifer characteristics ensures that formation material will not be drawn into the well. Otherwise, the pump should be set just above the top of the screen. Bailers, peristalic pumps, and miniature submersible pumps can also be used for purging, depending on well depth, groundwater level, and well yield. During purging, the temperature, pH, turbidity, and specific conductivity of the groundwater should be monitored at regular intervals and recorded in the site field logbook. The frequency of monitoring will depend on the purge rate but measurements are generally collected every 5 to 15 minutes. Purging is generally considered complete when these parameters stabilize. Depending on the formation characteristics and the degree of previous development, turbidity may also be a problem. Purging may have to be continued until the turbidity reaches an acceptable level, generally less than 50 nephelometric turbidity units (NTUs).

4.2 Sampling Equipment

The tendency of organics to adsorb or desorb onto or out of many materials makes the selection of sampling materials critical for trace organics analyses. Construction materials for samplers and purging equipment (bladders, pump, bailers, tubing) should be limited to stainless steel,



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polytetrafluoroethylene (Teflon^R), and glass in areas where concentrations are expected to be at or nearthe detection limit. The use of plastics, such as polyvinyl chloride (PVC) or polyethylene, should be avoided when analyzing for organics. However, PVC may be used for evacuation equipment as it will not normally come into contact with the sample. Rinsate blanks may be required to check the effectiveness of decontamination procedures when using non-dedicated equipment. In highly contaminated wells, disposable equipment (i.e., polypropylene bailers) may be appropriate to avoid cross-contamination.

4.3 Light Non-Aqueous Phase Liquids (LNAPL)

The presence of floating organic layers in a well may require reevaluation of the sampling plan. There is generally little point in sampling the groundwater directly beneath an organic layer and the presence of both phases complicates the sampling procedure. The organic phase is usually sampled by skimming the top of the liquid column in the well with a bailer or small pump, depending on the viscosity of the liquid.

5.0 EQUIPMENT/APPARATUS

5.1 Bailers

Advantages

- C No power source needed
- C Portable
- C Inexpensive, so it can be dedicated and hung in a well, thereby reducing the chances of cross contamination
- C Minimal outgassing of volatile organics while sample is in bailer
- C Readily available
- C Removes stagnant water first
- Rapid, simple method for removing small volumes of purge water

Disadvantages

- C Time-consuming to flush a large well
- C Transfer of sample may cause aeration
- C The valve at the bottom of the bailer often leaks thus losing some of the sample

5.2 Submersible Pumps

Advantages

C Smaller diameter pumps are usually portable and can be transported from well to well



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- C Relatively high pumping rates are possible
- C Generally very reliable and does not require priming

Disadvantages

- C Potential for effects on analysis of trace organics
- C Deep wells may require pumps that are heavy and cumbersome to use
- C Expensive
- C Power source needed
- C Sediment in water may clog intake screen or impellers
- C Must be decontaminated between wells

5.3 Non-Contact Gas Bladder Pumps

Advantages

- C Maintains integrity of sample
- C Easy to use
- Can sample from discrete locations within the monitor well

Disadvantages

- C Difficulty in cleaning, although dedicated tubing and bladder may be used
- C Only useful to a depth of about 100 feet
- Requires a supply of gas or an air compressor for operation, gas bottles or compressors are often difficult to obtain and are cumbersome
- C Relatively low pumping rates

5.4 Suction Pumps (including peristalic pumps)

Advantages

- C Portable, inexpensive, and readily available
- C Operates from either 110 VAC or 12 VDC
- C Variable flow rate, easily controlled

Disadvantages

- Restricted to wells where water levels are within 20 to 25 feet of the ground surface
- C Vacuum can cause loss of dissolved gasses and volatile organics
- C Some types must be primed and vacuum is often difficult to maintain during initial stages of pumping



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C Generally suitable for only small diameter shallow wells; maximum flow rate of some types (e.g. peristalic pumps) limited to approximately one gallon per minute (gpm)

5.5 Inertia Pumps

Advantages

- C Portable, inexpensive, and readily available
- C Offers a rapid method for purging relatively shallow wells

Disadvantages

- Restricted to areas with water levels within 70 feet of the ground surface
- C May be time consuming to purge wells with these manual pumps
- C Labor intensive
- WaTerra pumps (for example) are only effective in 2-inch diameter wells

5.6 Field Equipment Checklist

5.6.1 General

- C Water level indicator
 - electric sounder
 - steel tape
 - transducer
 - reflection sounder
 - airline
- C Depth sounder
- C Appropriate keys for well cap locks
- C Steel brush
- C HNU or OVA (whichever is most appropriate)
- C Logbook (bound)
- Calculator
- C Field data sheets and samples labels
- Chain of custody records and seals
- C Sample containers
- C Engineer's rule
- C Sharp knife (locking blade)
- C Tool box (to include at least: screwdrivers, pliers, hacksaw, hammer, flashlight, adjustable wrench)
- C Leather work gloves
- C Surgical gloves (for sampling)



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	C	Appropriate Health & Safety gear		
	C Five-gallon pail C Plastic sheeting			
	Plastic sheeting			
	C	Shipping containers		
	Packing materials			
	C Packing materials C Bolt cutters			
	C	Ziploc® plastic bags		
	C Containers for evacuation liquids			
	Decontamination solutions			
	Tap water			
	Non phosphate soap			
C Non phosphate soap C Pails or tubs		Pails or tubs		
C Aluminum foil		Aluminum foil		
	C	Garden sprayer		
	C	Preservatives		
	C	Distilled or deionized water		
	C	Fire extinguisher (if using a generator as a power source)		
	C	In-line filters, 0.45 microns (µm)		
	C	pH meter, temperature meter specific conductivity meter, turbidity meter		
	C	Indelible markers		
	C	Duct tape		
	C	Paper towels		
	C	First aid kit		
5.6.2	Bailers			
	C	Clean, decontaminated bailers of appropriate size and construction material		
	C	Unused nylon line, enough to dedicate to each well		
	C	Teflon® coated bailer wire		
	C	Sharp knife		
	C	Aluminum foil (to wrap clean bailers)		
	C	Five gallon bucket		
5.6.3	Submersible Pumps			
	C	Pump(s)		
	C	Generator (120, or 240 volts) or 12 volt power source, depending on pump		
	C	Extension cords		
	C	PVC coil tubing, diameter suitable for flow requirements		
	C	Hose clamps		
	C	Safety cable		
	C	Tool box		



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- pipe wrenches
- wire strippers
- electrical tape
- heat shrink wrap or tubing
- hose connectors
- Teflon tape
- Winch, pulley or hoist for large submersible pumps (4-inch diameter or greater)
- C Gasoline container, gasoline
- C Flow meter and gate valve
- C Plumbing components (nipples, reducers, plastic pipe connectors)
- Control box (if necessary)

5.6.4 Non-Contact Gas Bladder Pumps

- C Non-contact gas bladder pump
- C Compressor or nitrogen gas tank
- C Batteries and charger
- C Teflon tubing enough to dedicate to each well
- C Swagelock fitting
- C Toolbox supplements same as submersible pump
- Control box (if necessary)

5.6.5 Suction Pumps

- C Pumr
- C Black PVC coil tubing enough to dedicate to each well
- C Gasoline if required
- C Toolbox
- C Plumbing fittings
- C Flow meter with gate valve

5.6.6 Inertia Pumps

- C Pump assembly (WaTerra pump, piston pump)
- C Five gallon bucket

5.6.7 Peristalic Pumps

- C Small diameter "Geotubing"
- C Roll of MasterflexTM tubing
- C 110 VAC generator or 12 VDC power source
- C Knife, screwdriver



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6.0 REAGENTS

Reagents may be used for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed and are summarized in Environmental Response Team Center/Response Engineering Analytical Contract (ERT/REAC) SOP #2003, Sample Storage, Preservation, and Handling. Decontamination solutions are specified in ERT/REAC SOP #2006, Sampling Equipment Decontamination.

7.0 PROCEDURES

7.1 Preparation

- 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed (i.e, diameter and depth of wells to be sampled).
- 2. Obtain necessary sampling and monitoring equipment, appropriate to the type of contaminant being investigated. For collection of volatile organic samples, refer to the work plan to ensure that sufficient 40 milliliter (mL) glass sample vials with Teflon lined septa are available. Check availability of preservatives, packing material, sample labels, and coolers. Trip blanks are incorporated into the shipment package to provide a check against cross contamination.
- 3. Decontaminate or pre-clean equipment and ensure that it is in working order.
- 4. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
- 5. Identify all sampling locations.

7.2 Field Preparation

- 1. Start at the least contaminated well, if known.
- 2. Lay plastic sheeting around the well to minimize likelihood of equipment contamination from the soil adjacent to the well.
- 3. Remove locking well cap, note location, time of day, and date in field notebook or appropriate log form.
- 4. Remove well casing cap.



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- 5. Immediately screen headspace of well with an appropriate air monitoring instrument to determine the presence of volatile organic compounds and record flame ionization detector (FID) or photoionization detector (PID) readings in site logbook.
- 6. Measure distance from water surface to a reference measuring point and record in site logbook. A reference point may be the top of outer protective casing, the top of riser pipe, the ground surface, or the top of a concrete pad. If floating organics are present, the water level and depth to floating product can be measured with an oil/water interface probe. However, the presence of floating organics will indicate the need to reevaluate the validity of groundwater sampling.
- 7. Measure total depth of well and record in site logbook or on field data sheet.
- 8. Calculate the volume of water in the well and the volume to be purged using the calculations in Section 8.0.
- 9. Select the appropriate purging and sampling equipment.

7.3 Purging

The amount of purging required before sampling depends on the intent of the monitoring program as well as the hydrogeologic conditions. General assessment of groundwater quality may require long pumping periods to obtain a sample representative of a large volume of the aquifer. The purge volume is determined prior to sampling and the sample is collected after a known volume of the water is pumped from the well, or the well can be pumped until parameters such as temperature, specific conductivity,pH, or turbidity have stabilized. Groundwater quality in the well is considered stabilized after three sets of consecutive readings indicate no change. The time between readings is based on the purge rate and cumulative volume but generally is between 5 to 15 minutes.

Sampling to define a contaminant plume requires a representative sample from a small volume of the aquifer. This requires that the well be purged enough to remove the stagnant water but not enough to induce flow from other areas. Generally, three well volumes are considered sufficient. The total volume purged, purge method, purge rate, and the start and end times of purging are recorded in the field log book.

The following purging devices are most commonly used. Other evacuation devices are available, but have been omitted in this discussion due to their limited use.

7.3.1 Bailers

Bailers are the simplest purging device and generally consist of a rigid length of tube, usually with a ball check-valve at the bottom. A nylon line is used to tie and lower the bailer into the



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well and retrieve a volume of water. The three most common types of bailers are made of PVC, Teflon®, and stainless steel. Purging with bailers is best suited to shallow or small diameter wells. For deep, larger diameter wells that require removal of large volumes of water, pumps may be more appropriate.

Equipment needed will include a clean decontaminated bailer, Teflon® or nylon line, a sharp knife, and plastic sheeting.

- Determine the volume of water to be purged as described in Section 8.0, Calculations.
- 2. Lay plastic sheeting around the well to prevent contamination of the bailer line with soil or other foreign materials. Do not let the bailer line touch the ground.
- 3. Attach the line to the bailer and lower into the well until the bailer is completely submerged.
- 4. Pull bailer out ensuring that the line either falls onto a clean area of plastic sheeting or never touches the ground.
- 5. Empty the bailer into a container of known volume to determine when the purge volume is reached.
- 6. Dispose of purge waters as specified in the work plan.

7.3.2 Submersible Pumps

The use of submersible pumps for purging is permissible provided they are constructed of noncontaminating materials. The chief drawback, however, is the difficulty in avoiding cross-contamination between wells. Some pumps can be easily disassembled for cleaning, but field decontamination may be difficult and require solvents that can affect sample analysis. The use of submersible pumps in multiple well-sampling programs, therefore, should be carefully considered against other sampling mechanisms (bailers, bladder pumps). In most cases, a sample can be collected by bailer after purging with a submersible pump; however, submersible pumps may be the only practical sampling device for extremely deep wells (greater than 300 feet of hydraulic head). Under those conditions, dedicated pump systems should be considered to eliminate the potential for cross-contamination of well samples.

Submersible pumps generally use either electric or compressed gas for power. Electric powered pumps can run off a 12 volt direct current (DC) rechargeable battery, or a 110 or 220 volt alternating current (AC) power supply. Gasoline used to power electrical generators is



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a potential source of contamination and should be kept well away from purging and sampling equipment. Those units powered by compressed air normally use a small electric or gaspowered air compressor. They may also use compressed gas (i.e., nitrogen) from bottles. Pumps are available for monitor wells of various depths and diameters.

The following steps describe the use of submersible pumps in purging a well:

- 1. Determine the volume of water to be purged as described in Section 8.0, *Calculations*.
- 2. Lay plastic sheeting around the well to prevent contamination of pumps, hoses or lines with soil or other foreign materials.
- 3. Assemble pump, hoses and safety cable, and lower the pump into the well. Make sure the pump is deep enough so as not to dewater the pump.
- 4. Attach flow meter to the outlet hose to measure the volume of water purged or measure with a container of known volume.
- 5. Use a ground fault circuit interrupter (GFCI) or ground the generator to avoid possible electric shock.
- 6. Attach power supply, and purge the well until the specified volume of water has been removed (or until field parameters, such as temperature, pH, conductivity, etc, have stabilized). Do not allow the pump to run dry. If the pumping rate exceeds the well recharge rate, reduce the pumping rate.
- 7. Collect and dispose of purge waters as specified in the work plan.

7.3.3 Non-Contact Gas Bladder Pumps

Pumps in this category may be dedicated to a well and include stainless steel and Teflon® Middleburg-squeeze bladder pumps such as IEA, TIMCO, Well Wizard,or Geolog.

- 1. Assemble Teflon[®] tubing, pump and charged control box.
- 2. Procedure for purging with a bladder pump is the same as for a submersible pump (Section 7.3.2).
- 3. Adjust flow rate to prevent violent movement of the hose as water is drawn in.

7.3.4 Suction Pumps



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Suction pumps include centrifugal, peristaltic and diaphragm. Diaphragm pumps can be used for relatively rapid purging and can be adjusted to a slower rate for sampling. The peristaltic pump is a low volume pump that uses rollers to squeeze the flexible tubing thereby creating suction. The tubing can be dedicated to a well to prevent cross-contamination. Peristaltic pumps, however, require a power source.

- 1. Assemble the pump, tubing, and power source if necessary.
- 2. Procedure for purging with a suction pump is exactly the same as for a submersible pump (Section 7.3.2).

7.3.5 Inertia Pumps

Inertia pumps such as the WaTerra pump and piston pump, are manually operated. These pumps are most appropriate to use when wells are too deep to bail by hand, too shallow or too small in diameter to warrant the use of a submersible pump. The pumps are made of plastic and may either be decontaminated or discarded after use.

- 1. Determine the volume of water to be purged as described in Section 8.0, *Calculations*.
- 2.. Assemble pump and lower to the appropriate depth in the well.
- 3. Begin pumping manually, discharging water into a five-gallon bucket (or other graduated vessel). Purge until a specified volume of water has been evacuated (or until field parameters such as temperature, pH, and conductivity, have stabilized).
- 4. Collect and dispose of purge waters as specified in the work plan.

7.4 Sampling

Before choosing a sampling device, the advantages or disadvantages of any one device, as outlined in Section 5, should be reviewed. It may be appropriate to use a different device to sample than that which was used to purge. The most common example of this is the use of a submersible pump to purge and a bailer to sample. Samples for volatile organics are collected first when sampling for more than one set of parameters, followed in order by samples for semivolatile organic and inorganic analyses.

7.4.1 Bailers



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The positive-displacement sampling bailer is perhaps the most appropriate for collection of water samples for volatile analysis. Other bailer types (messenger, bottom fill, etc.) are less desirable, but may be mandated by well conditions and desired sample depth. A sample is obtained with a bailer using the following steps:

- 1. Surround the monitor well with clean plastic sheeting.
- 2. Attach a line to a clean decontaminated bailer. Do not let the line touch the ground.
- 3. Lower the bailer slowly into the well. Stop lowering when adjacent to the screen or at the desired sample depth
- 4. Allow bailer to fill and then slowly retrieve the bailer from the well.
- 5. Remove the cap from the sample container and place it on the plastic sheet or in a location where it will not become contaminated. For VOC sampling precautions, see Section 7.6.
- 6. Slowly pour the sample from the bailer into the sample container. Any necessary preservative should be added to the sample container before sampling.
- 7. Repeat steps 3, 4, and 6 as necessary to fill the sample container(s).
- 8. Cap the sample container tightly and place the prelabeled sample container in a carrier.
- 9. Replace the well cap.
- 10. Log the collection time, sampling method, and analyses required for all samples in the site logbook and on field data sheets.
- 11. Package samples and complete necessary paperwork.

7.4.2 Submersible Pumps

Submersible pumps are not recommended for sampling but may be used in some situations. The generator and fuel (if needed) used to operate a submersible pump can be a source of contamination and should be kept separate from the sampling containers during transport and downwind during sampling.



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- 1. Allow the monitor well to recharge after purging, keeping the pump just above the screened section.
- 2. Attach a clean gate valve to the discharge hose (if not already fitted), and reduce the flow of water to a manageable rate.
- 3. Assemble the appropriate bottles.
- 4. If a gate valve is not available, run the water down the side of a clean jar and fill the sample bottles from the jar.
- 5. Cap the sample container tightly and place the prelabeled sample container in a carrier.
- 6. Replace the well cap.
- 7. Log all samples in the site logbook and on the field data sheets and label all of the samples.
- 8. Package samples and complete the necessary paperwork.
- 9. Transport sample(s) to the decontamination zone for preparation for transport to the analytical laboratory.
- 10. Upon sampling completion, remove pump and assembly and fully decontaminate the equipment prior to setting it into the next sample well. When possible, dedicate the pump tubing to the well.

7.4.3 Non-Contact Gas Bladder Pumps

Non-contact gas positive displacement bladder pumps are often used when dedicated pumps are required. These pumps are also suitable for shallow (less than 100 feet) wells. They are somewhat difficult to clean, but may be used with dedicated sample tubing to avoid cleaning. These pumps require a power supply and a compressed gas supply (or compressor). They may be operated at variable flow and pressure rates making them ideal for both purging and sampling. Barcelona et al. (1984) and Nielsen and Yeates (1985) report that the non-contact gas positive displacement pumps cause the least amount of alteration in sample integrity as compared to other sample retrieval methods.

1. Allow the well to recharge after purging.



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- 2. Assemble the appropriate bottles.
- 3. Turn the pump on, increase the cycle time and reduce the pressure to the minimum that will allow the sample to come to the surface.
- 4. Non-filtered samples shall be collected directly from the outlet tubing into the sample bottle.
- 5. For filtered samples, connect the pump outlet tubing directly to the filter unit. The pump pressure should be minimized so that the pressure build up on the filter does not blow out the pump bladder or displace the filter. For the Geotech barrel filter, no actual connections are necessary.
- 6. Cap the sample container tightly and place the prelabeled sample container in a carrier.
- 7. Replace the well cap.
- 8. Log all samples in the site logbook and on the field data sheets, and label all samples.
- 9. Package samples and complete the necessary paperwork.
- 10. Transport sample(s) to the decontamination zone for preparation for transport to the analytical laboratory.
- 11. On completion, remove the tubing from the well and either replace the Teflon tubing and bladder with new dedicated tubing and bladder or rigorously decontaminate the existing materials.

7.4.4 Suction Pumps

Suction pumps are not recommended for sampling because it is operated by a vacuum and could remove volatile organics from the sample.

7.4.5 Inertia Pumps

Inertia pumps may be used to collect samples. It is more common, however, to purge with these pumps and sample with a bailer (Section 7.4.1).

1. Following well evacuation, allow the well to recharge.



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- 2. Assemble the appropriate bottles.
- 3. Because these pumps are manually operated, the flow rate may be regulated by the sampler. The sample may be discharged from the pump outlet directly into the sample container.
- 4. Cap the sample container tightly and place the prelabeled sample container in a carrier.
- 5. Replace the well cap.
- 6. Log all samples in the site logbook and on the field data sheets and label all samples.
- 7. Package samples and complete necessary paperwork.
- 8. Upon completion, remove pump and decontaminate or discard, as appropriate.

7.5 Filtering

Samples collected for dissolved metals analysis may require filtration. The filter must be changed or decontaminated between uses. Several type of filters are available. A barrel filter such as the "Geotech" works with a pneumatic (e.g. bicycle) pump, used to build up positive pressure in the chamber containing the sample, which is then forced through the filter paper (minimum size $0.45~\mu m$) into a jar placed underneath. The barrel itself is filled manually from the bailer or directly via the hose of the sampling pump. The pressure must be maintained up to 30 pounds/square inch (lbs/in²) by periodic pumping.

A vacuum type filter involves two chambers; the upper chamber contains the sample and a filter (minimum size $0.45~\mu m$) divides the chambers. Using a hand pump or a Gillian type pump, air is withdrawn from the lower chamber, creating a vacuum and thus causing the sample to move through the filter into the lower chamber where it is drained into a sample jar. Repeated pumping may be required to drain all the sample into the lower chamber. If preservation of the sample is necessary, this should be done after filtering.

An in-line filter may be used with a peristalic pump to transfer the sample from the original sample jar, through the filter, and into a new sample jar. In-line filters are used specifically for the preparation of groundwater samples for dissolved metals analysis, and for filtering large volumes of turbid groundwater. Groundwater samples collected for VOCs are generally not filtered. The filtering of groundwater is performed primarily to allow for the collection of silty or particulate-laden samples that would otherwise interfere with the laboratory analysis. The filters used in groundwater sampling are



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either cartridge type filters inserted into a reusable housing, or are self-contained and disposable. Disposable filters are preferred and often used to reduce cross-contamination of groundwater samples. Disposable filter chambers are usually constructed of polypropylene material, with an inert filtering material within the housing. Both reusable and disposable filters have barb or national pipe thread (NPT) fittings on the inlet and outlet sides of the housing to connect to \mathbf{d} " or \mathbf{e} " tubing.

7.6 Special Considerations for VOC Sampling

The proper collection of a sample for VOC analysis requires minimal disturbance of the sample to limit volatilization. Sample retrieval systems suitable for collection of volatile organic samples are: positive displacement bladder pumps, gear driven submersible pumps, syringe samplers and bailers (Barcelona et al, 1984; Nielsen and Yeates, 1985). Field conditions and other constraints will limit the choice of appropriate systems. The concern must be to collect a valid sample that has been subjected to the least amount of turbulence possible.

The following procedures should be used:

- 1. Open the vial, set cap in a clean place, and collect the sample. When collecting duplicates, collect both samples at the same time.
- 2. Fill the vial to just overflowing. Do not rinse the vial, or let it excessively overflow. There should be a convex meniscus on the top of the vial.
- 3. Check that the cap has not been contaminated (splashed) and carefully cap the vial. Place the cap directly over the top and screw down firmly. Do not overtighten and break the cap.
- 4. Invert the vial and tap gently. Observe vial for at least ten (10) seconds. If an air bubble appears, discard the sample and resample. It is imperative that no air is trapped in the sample vial.
- 5. The holding time for samples to be analyzed for VOCs is seven days. Samples should be shipped or delivered to the laboratory in as short a time as practical in order to arrive before the holding time has expired. Ensure that the samples are stored at 4EC during transport but do not allow them to freeze. The most readily available method of cooling is to use ice packed in double-sealed plastic bags (Ziploc® baggies).

8.0 CALCULATIONS

If it is necessary to calculate the volume of the well, use the following equation:

Well Volume (gallons) = pr^2hk [Equation 1]



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where:

 $\mathbf{p} = 3.14$

r = radius of monitor well (feet)

height of the water column (feet). This may be determined by subtracting the depth
 to water from the total depth of the well as measured from the same reference point.

k = conversion factor, 7.48 gallons per cubic foot (gal/ft³)

Monitor well diameters typically have a diameter of 2 to 4 inches. If the diameter of the monitor well is known, standard conversion factors can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitor well diameters can be calculated as follows:

 $V(gal/ft) = pr^2k$ or $V = 23.5r^2$ [Equation 2]

where:

p = 3.14

r = radius of monitoring well (feet) k = conversion factor (7.48 gal/ft³)

For a 2-inch diameter well, the volume, in gallons per linear foot, can be calculated as follows:

V/linear ft =
$$pr^2k$$
 [Equation 2]
= 3.14 (1/12)² (7.48 gal/ft³)
= 0.163 gal/ft

The well radius must be in feet to be able to use the equation.

The conversion factors (f) for the most common diameter monitor wells are as follows:

Well diameter-inches 2 3 4 6
Volume (gal/ft.) 0.1631 0.3670 0.6528 1.4680

If you use the conversation factors above, Equation 1 should be modified as follows:

Well V = hf [Equation 3]

where:

h = height of water column (feet)

f = conversion factor



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9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities that apply to the implementation of these procedures. However, the following general QA procedures apply:

- 1. All sample collection data, including purge methods and time, sample collection methods, times of collection, analyses required, and decontamination procedures (if any) must be documented on field data sheets or within site logbooks.
- 2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration must occur prior to purging or sampling and should be done according to the instruction manuals supplied by the manufacturer. All calibration procedures should be documented in the site logbook.
- 3. The collection of rinsate blanks is recommended to evaluate potential for cross contamination from the purging and/or sampling equipment.
- 4. Trip blanks are required if analytical parameters include VOCs.

10.0 DATA VALIDATION

This section does not apply to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA) or REAC health and safety guidelines. More specifically, depending upon the site specific contaminants, various protective programs must be implemented prior to sampling the first well. The site health and safety plan should be reviewed with specific emphasis placed on the protection program planned for the well sampling tasks. Standard safe operating practices should be followed such as minimizing contact with potential contaminants in both the vapor phase and liquid matrix through the use of respirators and disposable clothing.

When working around volatile organic contaminants:

- 1. Avoid breathing volatile constituents venting from the well.
- 2. Check the well head-space with a FID/PID prior to sampling.
- 3. If monitoring results indicate organic constituents, it may be necessary to conduct sampling activities in Level C protection. At a minimum, skin protection will be afforded by disposable protective



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clothing.

Physical hazards associated with well sampling:

- 1. Lifting injuries associated with pump and bailers retrieval; moving equipment.
- 2. Use of pocket knives for cutting discharge hose.
- 3. Heat/cold stress as a result of exposure to extreme temperatures in protective clothing.
- 4. Slip, trip, fall conditions as a result of pump discharge.
- 5. Restricted mobility due to the wearing of protective clothing.
- 6. Electrical shock associated with use of submersible pumps is possible. Use a GFCI or a copper grounding stake to avoid this problem.

12.0 REFERENCES

Barcelona, M.J., J.A. Helfrich, E.E. Garske, J.P. Gibb. 1984. "A Laboratory Evaluation of Groundwater Sampling Mechanisms." *Groundwater Monitoring Review*. p. 32-41.

Barcelona, M.J., J.A. Helfrich, E.E. Garske. 1985. "Sampling Tubing Effects on Groundwater Samples." *Analytical Chemistry*. Vol. 57. p. 460-463.

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13.0 APPENDICES

This section does not apply to this SOP.



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12.0 REFERENCES

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SUPERCEDES: SOP #2006; Revision 3.0; 1/23/92; U.S. EPA Contract 68-03-3482.



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SAMPLING EQUIPMENT DECONTAMINATION

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination and to provide general guidelines for developing decontamination procedures for sampling equipment to be used during hazardous waste operations as per 29 Code of Federal Regulations (CFR) 1910.120. This SOP does not address personnel decontamination.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitation, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Removing or neutralizing contaminants from equipment minimizes the likelihood of sample cross contamination, reduces or eliminates transfer of contaminants to clean areas, and prevents the mixing of incompatible substances.

Gross contamination can be removed by physical decontamination procedures. These abrasive and non-abrasive methods include the use of brushes, air and wet blasting, and high and low pressure water cleaning.

The first step, a soap and water wash, removes all visible particulate matter and residual oils and grease. This may be preceded by a steam or high pressure water wash to facilitate residuals removal. The second step involves a tap water rinse and a distilled/deionized water rinse to remove the detergent. An acid rinse provides a low pH media for trace metals removal and is included in the decontamination process if metal samples are to be collected. It is followed by another distilled/deionized water rinse. If sample analysis does not include metals, the acid rinse step can be omitted. Next, a high purity solvent rinse is performed for trace organics removal if organics are a concern at the site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. Acetone is typically chosen because it is an excellent solvent, miscible in water, and not a target analyte on the Priority Pollutant List. If acetone is known to be a contaminant of concern at a given site or if Target Compound List analysis (which includes acetone) is to be performed, another solvent may be substituted. The solvent must be allowed to evaporate completely and then a final distilled/deionized water rinse is performed. This rinse removes any residual traces of the solvent.

The decontamination procedure described above may be summarized as follows:

- 1. Physical removal
- 2. Non-phosphate detergent wash
- 3. Tap water rinse
- 4. Distilled/deionized water rinse



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- 5. 10% nitric acid rinse
- 6. Distilled/deionized water rinse
- 7. Solvent rinse (pesticide grade)
- 8. Air dry
- 9. Distilled/deionized water rinse

If a particular contaminant fraction is not present at the site, the nine (9) step decontamination procedure specified above may be modified for site specificity. For example, the nitric acid rinse may be eliminated if metals are not of concern at a site. Similarly, the solvent rinse may be eliminated if organics are not of concern at a site. Modifications to the standard procedure should be documented in the site specific work plan or subsequent report.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest. For the soil and water matrices, these are discussed in ERT/REAC SOP #2003, Sample Storage, Preservation and Handling. For air and waste samples, sample preservation, containers, handling, and storage are discussed in the specific SOPs for the technique selected.

More specifically, sample collection and analysis of decontamination waste may be required before beginning proper disposal of decontamination liquids and solids generated at a site. This should be determined prior to initiation of site activities.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte free (specifically for the contaminants of concern).
- The use of an untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal or industrial water treatment system.
- If acids or solvents are utilized in decontamination they raise health and safety, and waste disposal concerns.
- Damage can be incurred by acid and solvent washing of complex and sophisticated sampling equipment.

5.0 EQUIPMENT/APPARATUS

Decontamination equipment, materials, and supplies are generally selected based on availability. Other considerations include the ease of decontaminating or disposing of the equipment. Most equipment and



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supplies can be easily procured. For example, soft-bristle scrub brushes or long-handled bottle brushes can be used to remove contaminants. Large galvanized wash tubs, stock tanks, or buckets can hold wash and rinse solutions. Children's wading pools can also be used. Large plastic garbage cans or other similar containers lined with plastic bags can help segregate contaminated equipment. Contaminated liquid can be stored temporarily in metal or plastic cans or drums.

The following standard materials and equipment are recommended for decontamination activities:

5.1 Decontamination Solutions

Non-phosphate detergent Selected solvents (acetone, hexane, nitric acid, etc.) Tap water Distilled or deionized water

5.2 Decontamination Tools/Supplies

Long and short handled brushes
Bottle brushes
Drop cloth/plastic sheeting
Paper towels
Plastic or galvanized tubs or buckets
Pressurized sprayers (H₂O)
Solvent sprayers
Aluminum foil

5.3 Health and Safety Equipment

Appropriate personal protective equipment (i.e., safety glasses or splash shield, appropriate gloves, aprons or coveralls, respirator, emergency eye wash)

5.4 Waste Disposal

Trash bags Trash containers 55-gallon drums

Metal/plastic buckets/containers for storage and disposal of decontamination solutions

6.0 REAGENTS

There are no reagents used in this procedure aside from the actual decontamination solutions. Table 1 (Appendix A) lists solvent rinses which may be required for elimination of particular chemicals. In general, the following solvents are typically utilized for decontamination purposes:



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- 10% nitric acid is typically used for inorganic compounds such as metals. An acid rinse may not be required if inorganics are not a contaminant of concern.
- Acetone (pesticide grade)⁽¹⁾
- Hexane (pesticide grade)⁽¹⁾
- Methanol⁽¹⁾

7.0 PROCEDURES

As part of the health and safety plan, a decontamination plan should be developed and reviewed. The decontamination line should be set up before any personnel or equipment enter the areas of potential exposure. The equipment decontamination plan should include:

- The number, location, and layout of decontamination stations.
- Decontamination equipment needed.
- Appropriate decontamination methods.
- Methods for disposal of contaminated clothing, equipment, and solutions.
- Procedures can be established to minimize the potential for contamination. This may include: (1) work practices that minimize contact with potential contaminants; (2) using remote sampling techniques; (3) covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material; (4) watering down dusty areas; (5) avoiding laying down equipment in areas of obvious contamination; and (6) use of disposable sampling equipment.

7.1 Decontamination Methods

All samples and equipment leaving the contaminated area of a site must be decontaminated to remove any contamination that may have adhered to equipment. Various decontamination methods will remove contaminants by: (1) flushing or other physical action, or (2) chemical complexing to inactivate contaminants by neutralization, chemical reaction, disinfection, or sterilization.

Physical decontamination techniques can be grouped into two categories: abrasive methods and non-abrasive methods, as follows:

7.1.1 Abrasive Cleaning Methods

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The mechanical abrasive cleaning methods are most commonly used at hazardous waste sites. The following abrasive methods are available:

^{(1) -} Only if sample is to be analyzed for organics.



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Mechanical

Mechanical methods of decontamination include using metal or nylon brushes. The amount and type of contaminants removed will vary with the hardness of bristles, length of time brushed, degree of brush contact, degree of contamination, nature of the surface being cleaned, and degree of contaminant adherence to the surface.

Air Blasting

Air blasting equipment uses compressed air to force abrasive material through a nozzle at high velocities. The distance between nozzle and surface cleaned, air pressure, time of application, and angle at which the abrasive strikes the surface will dictate cleaning efficiency. Disadvantages of this method are the inability to control the amount of material removed and the large amount of waste generated.

Wet Blasting

Wet blast cleaning involves use of a suspended fine abrasive. The abrasive/water mixture is delivered by compressed air to the contaminated area. By using a very fine abrasive, the amount of materials removed can be carefully controlled.

7.1.2 Non-Abrasive Cleaning Methods

Non-abrasive cleaning methods work by forcing the contaminant off a surface with pressure. In general, the equipment surface is not removed using non-abrasive methods.

Low-Pressure Water

This method consists of a container which is filled with water. The user pumps air out of the container to create a vacuum. A slender nozzle and hose allow the user to spray in hard-to-reach places.

High-Pressure Water

This method consists of a high-pressure pump, an operator controlled directional nozzle, and a high-pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres (atm) and flow rates usually range from 20 to 140 liters per minute.



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<u>Ultra-High-Pressure Water</u>

This system produces a water jet that is pressured from 1,000 to 4,000 atmospheres. This ultra-high-pressure spray can remove tightly-adhered surface films. The water velocity ranges from 500 meters/second (m/s) (1,000 atm) to 900 m/s (4,000 atm). Additives can be used to enhance the cleaning action.

Rinsing

Contaminants are removed by rinsing through dilution, physical attraction, and solubilization.

Damp Cloth Removal

In some instances, due to sensitive, non-waterproof equipment or due to the unlikelihood of equipment being contaminated, it is not necessary to conduct an extensive decontamination procedure. For example, air sampling pumps hooked on a fence, placed on a drum, or wrapped in plastic bags are not likely to become heavily contaminated. A damp cloth should be used to wipe off contaminants which may have adhered to equipment through airborne contaminants or from surfaces upon which the equipment was set.

Disinfection/Sterilization

Disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization methods are impractical for large equipment. This method of decontamination is typically performed off-site.

7.2 Field Sampling Equipment Decontamination Procedures

The decontamination line is setup so that the first station is used to clean the most contaminated item. It progresses to the last station where the least contaminated item is cleaned. The spread of contaminants is further reduced by separating each decontamination station by a minimum of three (3) feet. Ideally, the contamination should decrease as the equipment progresses from one station to another farther along in the line.

A site is typically divided up into the following boundaries: Hot Zone or Exclusion Zone (EZ), the Contamination Reduction Zone (CRZ), and the Support or Safe Zone (SZ). The decontamination line should be setup in the Contamination Reduction Corridor (CRC) which is in the CRZ. Figure 1 (Appendix B) shows a typical contaminant reduction zone layout. The CRC controls access into and out of the exclusion zone and confines decontamination activities to a limited area. The CRC boundaries should be conspicuously marked. The far end is the hotline, the boundary between the exclusion zone and the contamination reduction zone. The size of the decontamination corridor



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depends on the number of stations in the decontamination process, overall dimensions of the work zones, and amount of space available at the site. Whenever possible, it should be a straight line.

Anyone in the CRC should be wearing the level of protection designated for the decontamination crew. Another corridor may be required for the entry and exit of heavy equipment. Sampling and monitoring equipment and sampling supplies are all maintained outside of the CRC. Personnel don their equipment away from the CRC and enter the exclusion zone through a separate access control point at the hotline. One person (or more) dedicated to decontaminating equipment is recommended.

7.2.1 Decontamination Setup

Starting with the most contaminated station, the decontamination setup should be as follows:

Station 1 Segregate Equipment Drop

Place plastic sheeting on the ground (Figure 2, Appendix B). Size will depend on amount of equipment to be decontaminated. Provide containers lined with plastic if equipment is to be segregated. Segregation may be required if sensitive equipment or mildly contaminated equipment is used at the same time as equipment which is likely to be heavily contaminated.

Station 2 Physical Removal With A High-Pressure Washer (Optional)

As indicated in 7.1.2, a high-pressure wash may be required for compounds which are difficult to remove by washing with brushes. The elevated temperature of the water from the high-pressure washers is excellent at removing greasy/oily compounds. High pressure washers require water and electricity.

A decontamination pad may be required for the high-pressure wash area. An example of a wash pad may consist of an approximately 1 1/2 foot-deep basin lined with plastic sheeting and sloped to a sump at one corner. A layer of sand can be placed over the plastic and the basin is filled with gravel or shell. The sump is also lined with visqueen and a barrel is placed in the hole to prevent collapse. A sump pump is used to remove the water from the sump for transfer into a drum.

Typically heavy machinery is decontaminated at the end of the day unless site sampling requires that the machinery be decontaminated frequently. A separate decontamination pad may be required for heavy equipment.

Station 3 Physical Removal With Brushes And A Wash Basin

Prior to setting up Station 3, place plastic sheeting on the ground to cover areas under Station 3 through Station 10.



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Fill a wash basin, a large bucket, or child's swimming pool with non-phosphate detergent and tap water. Several bottle and bristle brushes to physically remove contamination should be dedicated to this station . Approximately 10 - 50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 4 Water Basin

Fill a wash basin, a large bucket, or child's swimming pool with tap water. Several bottle and bristle brushes should be dedicated to this station. Approximately 10 - 50 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 5 Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to contain the water during the rinsing process. Approximately 10-20 gallons of water may be required initially depending upon the amount of equipment to decontaminate and the amount of gross contamination.

Station 6 Nitric Acid Sprayers

Fill a spray bottle with 10% nitric acid. An acid rinse may not be required if inorganics are not a contaminant of concern. The amount of acid will depend on the amount of equipment to be decontaminated. Provide a 5-gallon bucket or basin to collect acid during the rinsing process.

Station 7 Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to collect water during the rinsate process.

Station 8 Organic Solvent Sprayers

Fill a spray bottle with an organic solvent. After each solvent rinse, the equipment should be rinsed with distilled/deionized water and air dried. Amount of solvent will depend on the amount of equipment to decontaminate. Provide a 5-gallon bucket or basin to collect the solvent during the rinsing process.

Solvent rinses may not be required unless organics are a contaminant of concern, and may be eliminated from the station sequence.



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Station 9 Low-Pressure Sprayers

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to collect water during the rinsate process.

Station 10 Clean Equipment Drop

Lay a clean piece of plastic sheeting over the bottom plastic layer. This will allow easy removal of the plastic in the event that it becomes dirty. Provide aluminum foil, plastic, or other protective material to wrap clean equipment.

7.2.2 Decontamination Procedures

Station 1 Segregate Equipment Drop

Deposit equipment used on-site (i.e., tools, sampling devices and containers, monitoring instruments radios, clipboards, etc.) on the plastic drop cloth/sheet or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross contamination. Loose leaf sampling data sheets or maps can be placed in plastic zip lock bags if contamination is evident.

Station 2 Physical Removal With A High-Pressure Washer (Optional)

Use high pressure wash on grossly contaminated equipment. Do not use high-pressure wash on sensitive or non-waterproof equipment.

Station 3 Physical Removal With Brushes And A Wash Basin

Scrub equipment with soap and water using bottle and bristle brushes. Only sensitive equipment (i.e., radios, air monitoring and sampling equipment) which is waterproof should be washed. Equipment which is not waterproof should have plastic bags removed and wiped down with a damp cloth. Acids and organic rinses may also ruin sensitive equipment. Consult the manufacturers for recommended decontamination solutions.

Station 4 Equipment Rinse

Wash soap off of equipment with water by immersing the equipment in the water while brushing. Repeat as many times as necessary.

Station 5 Low-Pressure Rinse

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.



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<u>Station 6</u> <u>Nitric Acid Sprayers (required only if metals are a contaminant of concern)</u>

Using a spray bottle rinse sampling equipment with nitric acid. Begin spraying (inside and outside) at one end of the equipment allowing the acid to drip to the other end into a 5-gallon bucket. A rinsate blank may be required at this station. Refer to Section 9.

Station 7 Low-Pressure Sprayers

Rinse sampling equipment with distilled/deionized water with a low-pressure sprayer.

Station 8 Organic Solvent Sprayers

Rinse sampling equipment with a solvent. Begin spraying (inside and outside) at one end of the equipment allowing the solvent to drip to the other end into a 5-gallon bucket. Allow the solvent to evaporate from the equipment before going to the next station. A QC rinsate sample may be required at this station.

Station 9 Low-Pressure Sprayers

Rinse sampling equipment with distilled/deionized water with a low-pressure washer.

Station 10 Clean Equipment Drop

Lay clean equipment on plastic sheeting. Once air dried, wrap sampling equipment with aluminum foil, plastic, or other protective material.

7.2.3 Post Decontamination Procedures

- Collect high-pressure pad and heavy equipment decontamination area liquid and
 waste and store in appropriate drum or container. A sump pump can aid in the
 collection process. Refer to the Department of Transportation (DOT) requirements
 for appropriate containers based on the contaminant of concern.
- 2. Collect high-pressure pad and heavy equipment decontamination area solid waste and store in appropriate drum or container. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- 3. Empty soap and water liquid wastes from basins and buckets and store in appropriate drum or container. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- Empty acid rinse waste and place in appropriate container or neutralize with a base and place in appropriate drum. pH paper or an equivalent pH test is required for neutralization. Consult DOT requirements for appropriate drum for acid rinse waste.



STANDARD OPERATING PROCEDURES

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SAMPLING EQUIPMENT DECONTAMINATION

- 5. Empty solvent rinse sprayer and solvent waste into an appropriate container. Consult DOT requirements for appropriate drum for solvent rinse waste.
- 6. Using low-pressure sprayers, rinse basins, and brushes. Place liquid generated from this process into the wash water rinse container.
- 7. Empty low-pressure sprayer water onto the ground.
- 8. Place all solid waste materials generated from the decontamination area (i.e., gloves and plastic sheeting, etc.) in an approved DOT drum. Refer to the DOT requirements for appropriate containers based on the contaminant of concern.
- 9. Write appropriate labels for waste and make arrangements for disposal. Consult DOT regulations for the appropriate label for each drum generated from the decontamination process.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

A rinsate blank is one specific type of quality control sample associated with the field decontamination process. This sample will provide information on the effectiveness of the decontamination process employed in the field. Rinsate blanks are samples obtained by running analyte free water over decontaminated sampling equipment to test for residual contamination. The blank water is collected in sample containers for handling, shipment, and analysis. These samples are treated identical to samples collected that day. A rinsate blank is used to assess cross contamination brought about by improper decontamination procedures. Where dedicated sampling equipment is not utilized, collect one rinsate blank per day per type of sampling device samples to meet QA2 and QA3 objectives. For further information, refer to ERT/REAC SOP #2005, Quality Control Samples.

If sampling equipment requires the use of plastic tubing it should be disposed of as contaminated and replaced with clean tubing before additional sampling occurs.

10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results in accordance with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow OSHA, U.S. EPA, corporate, and other applicable health and safety procedures.



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SAMPLING EQUIPMENT DECONTAMINATION

Decontamination can pose hazards under certain circumstances. Hazardous substances may be incompatible with decontamination materials. For example, the decontamination solution may react with contaminants to produce heat, explosion, or toxic products. Also, vapors from decontamination solutions may pose a direct health hazard to workers by inhalation, contact, fire, or explosion.

The decontamination solutions must be determined to be acceptable before use. Decontamination materials may degrade protective clothing or equipment; some solvents can permeate protective clothing. If decontamination materials do pose a health hazard, measures should be taken to protect personnel or substitutions should be made to eliminate the hazard. The choice of respiratory protection based on contaminants of concern from the site may not be appropriate for solvents used in the decontamination process.

Safety considerations should be addressed when using abrasive and non-abrasive decontamination equipment. Maximum air pressure produced by abrasive equipment could cause physical injury. Displaced material requires control mechanisms.

Material generated from decontamination activities requires proper handling, storage, and disposal. Personal Protective Equipment may be required for these activities.

Material safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard (i.e., acetone, alcohol, and trisodiumphosphate).

In some jurisdictions, phosphate containing detergents (i.e., TSP) are banned.

12.0 REFERENCES

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, February, 1988.

A Compendium of Superfund Field Operations Methods, EPA 540/p-87/001.

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, USEPA Region IV, April 1, 1986.

Guidelines for the Selection of Chemical Protective Clothing, Volume 1, Third Edition, American Conference of Governmental Industrial Hygienists, Inc., February, 1987.

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/USCG/EPA, October, 1985.



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SAMPLING EQUIPMENT DECONTAMINATION

APPENDIX A Table SOP #2006 August, 1994



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SAMPLING EQUIPMENT DECONTAMINATION

TABLE 1 Soluble Contaminants and Recommended Solvent Rinse					
SOLVENT ⁽¹⁾	EXAMPLES OF SOLVENTS	SOLUBLE CONTAMINANTS			
Water	Deionized water Tap water	Low-chain hydrocarbons Inorganic compounds Salts Some organic acids and other polar compounds			
Dilute Acids	Nitric acid Acetic acid Boric acid	Basic (caustic) compounds (e.g., amines and hydrazines)			
Dilute Bases	Sodium bicarbonate (e.g., soap detergent)	Acidic compounds Phenol Thiols Some nitro and sulfonic compounds			
Organic Solvents (2)	Alcohols Ethers Ketones Aromatics Straight chain alkalines (e.g., hexane) Common petroleum products (e.g., fuel, oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)			
Organic Solvent ⁽²⁾	Hexane	PCBs			

^{(1) -} Material safety data sheets are required for all decontamination solvents or solutions as required by the Hazard Communication Standard

^{(2) -} WARNING: Some organic solvents can permeate and/or degrade the protective clothing



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SAMPLING EQUIPMENT DECONTAMINATION

APPENDIX B Figures SOP #2006 August, 1994



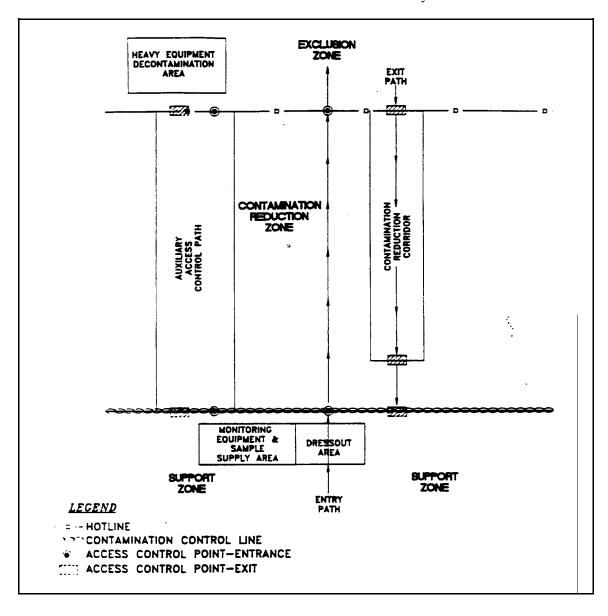
STANDARD OPERATING PROCEDURES

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SAMPLING EQUIPMENT DECONTAMINATION

FIGURE 1. Contamination Reduction Zone Layout



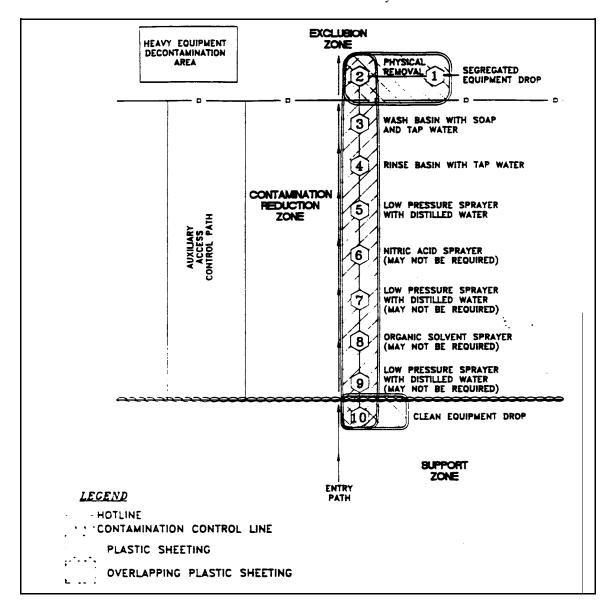


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SAMPLING EQUIPMENT DECONTAMINATION

FIGURE 2. Decontamination Layout





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SOIL SAMPLING

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SUPERCEDES: SOP #2012; Revision 0.0; 11/16/94; U.S. EPA Contract 68-C4-0022.



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SOIL SAMPLING

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of representative soil samples. Sampling depths are assumed to be those that can be reached without the use of a drill rig, direct-push, or other mechanized equipment (except for a back-hoe). Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the actual procedures used should be documented and described in an appropriate site report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a trier, a split-spoon, or, if required, a backhoe.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended. Samples should, however, be cooled and protected from sunlight to minimize any potential reaction. The amount of sample to be collected and proper sample container type are discussed in ERT/REAC SOP #2003 Rev. 0.0 08/11/94, *Sample Storage*, *Preservation and Handling*.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary potential problems associated with soil sampling - cross contamination of samples and improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.



STANDARD OPERATING PROCEDURES

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SOIL SAMPLING

5.0 EQUIPMENT

Soil sampling equipment includes the following:

C	Maps/plot plan	1
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- C Safety equipment, as specified in the site-specific Health and Safety Plan
- C Survey equipment or global positioning system (GPS) to locate sampling points
- C Tape measure
- C Survey stakes or flags
- Camera and film
- C Stainless steel, plastic, or other appropriate homogenization bucket, bowl or pan
- C Appropriate size sample containers
- C Ziplock plastic bags
- C Logbook
- C Labels
- Chain of Custody records and custody seals
- C Field data sheets and sample labels
- Cooler(s)
- C Ice
- C Vermiculite
- C Decontamination supplies/equipment
- Canvas or plastic sheet
- C Spade or shovel
- C Spatula
- C Scoop
- C Plastic or stainless steel spoons
- C Trowel(s)
- Continuous flight (screw) auger
- C Bucket auger
- C Post hole auger
- C Extension rods
- C T-handle
- C Sampling trier
- C Thin wall tube sampler
- C Split spoons
- C Vehimeyer soil sampler outfit
 - Tubes
 - Points
 - Drive head
 - Drop hammer
 - Puller jack and grip
- C Backhoe



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SOIL SAMPLING

6.0 REAGENTS

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in ERT/REAC SOP #2006 Rev. 0.0 08/11/94, *Sampling Equipment Decontamination*, and the site specific work plan.

7.0 PROCEDURES

7.1 Preparation

- 1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.
- 2. Obtain necessary sampling and monitoring equipment.
- 3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
- 4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.
- 5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.
- 6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations should be utility-cleared by the property owner or the On-Scene-Coordinator (OSC) prior to soil sampling; and utility clearance should always be confirmed before beginning work.

7.2 Sample Collection

7.2.1 Surface Soil Samples

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample.

This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required. Tools plated with chrome or other materials should not be used.



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SOIL SAMPLING

Plating is particularly common with garden implements such as potting trowels.

The following procedure is used to collect surface soil samples:

- 1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.
- 2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.
- 3. If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample fromanother sampling interval or location into the homogenization container and mixthoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle (Figure 1, Appendix A). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of approximately three feet.

The following procedure is used for collecting soil samples with the auger:



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SOIL SAMPLING

- 1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.
- 2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.
- 3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.
- 4. After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole and proceed to Step 10.
- 5. Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.
- 6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.
- 7. Remove the tube sampler, and unscrew the drill rods.
- 8. Remove the cutting tip and the core from the device.
- 9. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.
- 10. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly.



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SOIL SAMPLING

When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

- 11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.
- 12. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

7.2.3 Sampling with a Trier

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and used to extract a core sample from the appropriate depth.

The following procedure is used to collect soil samples with a sampling trier:

- 1. Insert the trier (Figure 2, Appendix A) into the material to be sampled at a 0° to 45° angle from horizontal. This orientation minimizes the spillage of sample.
- 2. Rotate the trier once or twice to cut a core of material.
- 3. Slowly withdraw the trier, making sure that the slot is facing upward.
- 4. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.



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SOIL SAMPLING

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D1586-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils".

The following procedures are used for collecting soil samples with a split spoon:

- 1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.
- 2. Place the sampler in a perpendicular position on the sample material.
- 3. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.
- 4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.
- 5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 1/2 inch diameters. A larger barrel may be necessary to obtain the required sample volume.
- 6. Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.

7.2.5 Test Pit/Trench Excavation

A backhoe can be used to remove sections of soil, when detailed examination of soil characteristics are required. This is probably the most expensive sampling method because of the relatively high cost of backhoe operation.

The following procedures are used for collecting soil samples fromtest pits or trenches:

- 1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of overhead and buried utilities.
- 2. Review the site specific Health & Safety plan and ensure that all safety precautions including appropriate monitoring equipment are installed as required.



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SOIL SAMPLING

- 3. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.
- 4. A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.
- 5. Samples are taken using a trowel, scoop, orcoring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.
- 6. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.
- Abandon the pit or excavation according to applicable state regulations.
 Generally, shallow excavations can simply be backfilled with the removed soil material.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

- 1. All data must be documented on field data sheets or within site logbooks.
- 2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities



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SOIL SAMPLING

must occur prior to sampling/operation, and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OHSA and corporate health and safety procedures, in addition to the procedures specified in the site specific Health & Safety Plan..

12.0 REFERENCES

Mason, B.J. 1983. Preparation of Soil Sampling Protocol: Technique and Strategies. EPA-600/4-83-020.

Barth, D.S. and B.J. Mason. 1984. Soil Sampling Quality Assurance User's Guide. EPA-600/4-84-043.

U.S. Environmental Protection Agency. 1984 Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA-600/4-84-076.

de Vera, E.R., B.P. Simmons, R.D. Stephen, and D.L. Storm. 1980. Samplers and Sampling Procedures for Hazardous Waste Streams. EPA-600/2-80-018.

ASTM D 1586-98, ASTM Committee on Standards, Philadelphia, PA.



STANDARD OPERATING PROCEDURES

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SOIL SAMPLING

APPENDIX A Figures SOP #2012 February 2000

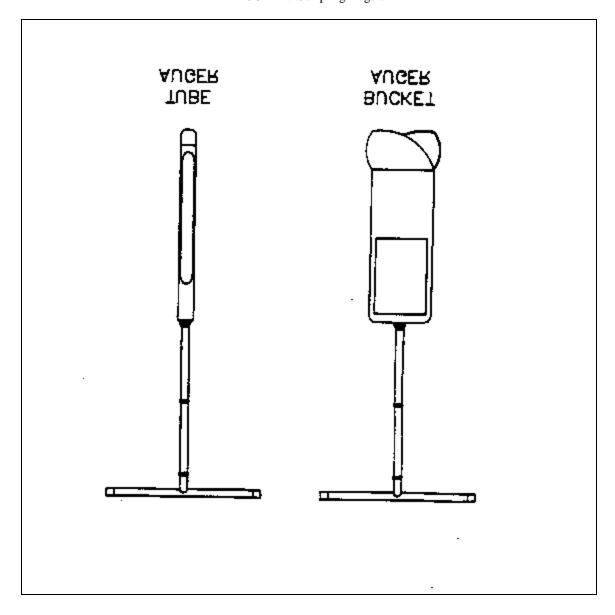


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SOIL SAMPLING

FIGURE 1. Sampling Augers



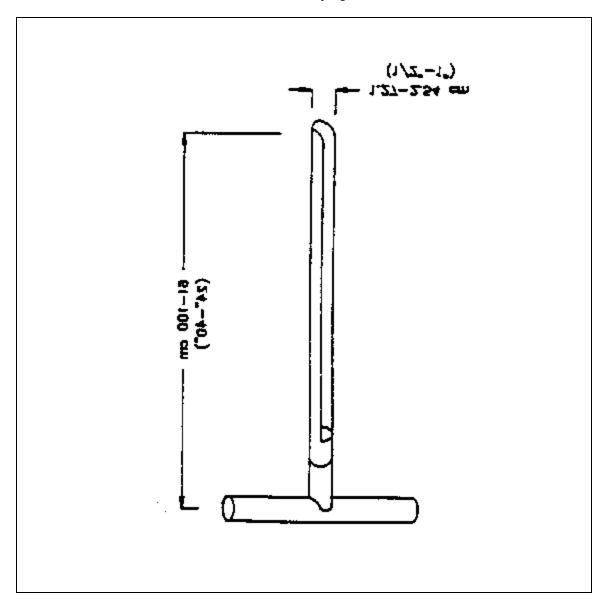


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SOIL SAMPLING

FIGURE 2. Sampling Trier





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MANUAL WATER LEVEL MEASUREMENTS

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	A - Example Field Data Sheet						

 $[\]ensuremath{^{*}}$ These sections affected by Revision 1.0



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MANUAL WATER LEVEL MEASUREMENTS

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to set guidelines for the determination of the depth to water measurements in an open borehole, a cased borehole, a monitor well, or a piezometer.

Generally, water-level measurement data from boreholes, piezometers, or monitor wells are used to construct water table or potentiometric surface maps, and to determine groundwater flow direction, groundwater level recovery following a pumping event, or to determine other aquifer characteristics. Therefore, all water level measurements at a given site should be collected within a 24-hour period. However, certain situations may produce rapidly changing groundwater levels that necessitate taking measurements within a condensed time frame. Rapid groundwater level changes may occur due to:

- Atmospheric pressure changes;
- Tidal influences;
- Changes in river stage, impoundments levels, or flow in unlined ditches;
- Pumping of nearby wells;
- Precipitation.

2.0 METHOD SUMMARY

A permanent survey mark should be placed on the top of the riser pipe or casing as a reference point for groundwater level measurements. If the lip of the riser pipe is not flat, the reference point may be located on the grout apron or the top of the outer protective casing (if present). If using a measurement reference point, it must be documented in the site logbook, the sampler's personal log book, or on field data sheets (Figure 1, Appendix A). All field personnel must be informed of the measurement reference point used in order to ensure the collection of comparable data. NOTE: All data recorded in the sampler's personal log book must be photocopied and retained in the project files.

Before measurements are made, water levels in piezometers and monitor wells should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low yield situations, recovery of water levels to static equilibrium may take longer. All measurements should be recorded to one hundredth (0.01) of a foot. Water level measuring equipment must be decontaminated prior to and after each use at each measuring location. When possible, measurements should be taken from the least to the most contaminated borehole, well, or piezometer.

Open the well and monitor the head space with an appropriate air monitoring instrument to determine the presence of volatile organic compounds (VOCs). For electrical sounders, ground the measuring equipment, and



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MANUAL WATER LEVEL MEASUREMENTS

then lower the water level probe into the well until the water surface is reached, as indicated by a tone or meter deflection. Record the distance from the water surface to the reference point. (Measurement with a chalked tape will necessitate lowering the tape below the water level and holding a convenient foot marker at the reference point. Record the water level as indicated on the chalked tape section and the depth mark held at the reference point. The depth to water is the difference between these two readings.) Remove the water level probe, replace the riser pipe cap, and decontaminate the equipment as necessary. Note: If a separate phase product is present, a product/water interface probe is required for the measurement of product thickness and water level.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

This section is not applicable to this SOP.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

- Cascading water, particularly in open-hole or rock wells and especially during aquifer pumping tests, may interfere with the water level measurement.
- Some older types of electric sounders are only marked at 5-foot intervals. A surveyor's tape is necessary to extrapolate between the 5-foot marks.
- Oil or other product floating on the water column can insulate the contacts of the probe on an electric sounder and give false readings. For accurate level measurements in wells containing separate phase product, a special product/water level indicator is required.
- Tapes (electrical or surveyor) may have damaged or missing sections, or may be spliced inaccurately. Always examine the tape for continuity and completeness.
- An air line may be the only available means to take measurements in sealed production wells, and is not described here. The method is generally accurate to approximately two-tenths (0.2) of a foot.
- When using a chalked steel tape, it is necessary to lower the tape below the water level in order to take
 a measurement. This method is more successful when the operator has knowledge of the approximate
 groundwater level.

5.0 EQUIPMENT/APPARATUS

- Electric water level indicator, marked in increments of 0.01-foot
- Steel tape, chalked, marked in increments of 0.01-foot



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MANUAL WATER LEVEL MEASUREMENTS

- Appropriate air monitoring equipment [photoionization detector (PID)] and/or flame ionization detector (FID)]
- Product/water interface probe
- Chalk
- Ruler/Measuring tape
- Site logbook, personal logbook, and/or field data sheets
- Decontamination supplies
- Paper towels and trash bags

6.0 REAGENTS

No chemical reagents are used in this procedure; however, decontamination solutions may be necessary. If decontamination of equipment is required, refer to Environmental Response Team/Response Engineering and Analytical Contract (ERT/REAC) SOP #2006, Sampling Equipment Decontamination, and the approved site Work Plan (WP).

7.0 PROCEDURES

7.1 Preparation

- 1. Determine the number of measurements needed, the methods to be employed, and the equipment and supplies needed.
- 2. Decontaminate or pre-clean equipment, and ensure that it is in working order.
- 3. Coordinate sampling schedule with staff, clients, and regulatory agency, if appropriate.
- 4. If this is an initial visit, perform a general site survey prior to site entry in accordance with the current approved site specific Health and Safety Plan (HASP).
- 5. Identify sampling locations.

7.2 Water Level Determination

1. If possible, and when applicable, measure those wells that are least contaminated and



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MANUAL WATER LEVEL MEASUREMENTS

proceed to those most contaminated.

- 2. Clean all the equipment used to measure water levels (which enters the well) by the following decontamination procedure:
 - C Rinse equipment with deionized water.
 - Wash the equipment with an Alconox solution , followed by a deionized water rinse.
 - Rinse the equipment with an appropriate solvent suitable for the type and material composition (e.g., methanol, isopropyl alcohol, acetone) as per the WP, if organic contamination is suspected.
 - C Triple rinse the equipment with deionized water.
 - C Place the equipment on clean surface such as a Teflon® or polyethylene sheet to air dry.
- 3. Remove the (locking) well cover, note the well identification (ID), the date and time of day, and the participating field personnel in the site logbook, a personal logbook, and/or on a field data sheet.
- 4. Remove well cap.
- 5. If organic contaminants are suspected, monitor the head space of the well with a photoionization detector (PID) or flame ionization detector (FID). Record the results in the site logbook, personal logbook, and/or on a field data sheet.
- 7. Lower a water-level measuring device into the well. Electrical tapes are lowered to the water surface. Chalked steel tapes are lowered generally a foot or more below the water surface; steel tapes are generally chalked so that a 1- to 5-foot long section will fall below the expected water level. Record all measurements in the site logbook, the sampler's personal log book, and/or on field data sheets. NOTE: All data recorded in a personal log book must be photocopied and retained in the project files.
- 8. For electrical tapes, record the distance from the water surface, as determined by the audio signal or meter, to the reference measuring point. For chalked tapes, an even foot mark is held at the reference point, once the chalked section of the tape is below the water level. Both the water level on the tape and the foot mark held at the reference point is recorded. The depth to the water is the difference between the two readings. In addition, note the



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MANUAL WATER LEVEL MEASUREMENTS

reference point used (top of the outer casing, top of the riser pipe, ground surface, or some other permanent reproducible position on the well head). Repeat the measurement to ensure reproducibility and accuracy. Preferably the same person and level measurement equipment should be used to eliminate any sources of error related to the measurement readings.

- 9. Remove all water level measuring equipment, replace the well cap and the locking steel caps.
- 10. Decontaminate all equipment as outlined in Step 2 (above), and store for transport to the next sampling location.
- 11. Note any physical changes, such as erosion or cracks in protective concrete pad or variation in the total depth of the well, in a site logbook, a personal logbook, and/or on a field data sheet.

8.0 CALCULATIONS

To determine groundwater elevation above mean sea level, use the following equation:

$$E_W = E - D$$

where:

 E_W = Elevation of water above mean sea level (feet) or local datum

E = Elevation above sea level or local datum at point of measurement (feet)

D = Depth to water (feet)

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

- 1. All data must be documented in site logbooks, personal logbooks, and/or field data sheets.
- 2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the WP.
- 3. Each well must be tested at least twice in order to compare results. If results do not agree within 0.02 of a foot, a third measurement must be taken and the readings averaged. Consistent failure of consecutive readings to agree suggests that levels are changing because of one or more conditions, as indicated in Section 1.



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MANUAL WATER LEVEL MEASUREMENTS

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potential hazardous materials, follow U.S. EPA, Occupational Safety and Health Administration (OSHA) and corporate health and safety procedures.

If the FID/PID results obtained while monitoring the head space and breathing zones indicate that VOCs are present, the personal protection level may need to be upgraded from that denoted in the HASP.

12.0 REFERENCES

Driscoll, F.G. 1986. Groundwater and Wells. *Collection and Analysis of Pumping Test Data*. 2nd ed. Chapter 16. St. Paul, Minnesota: Johnson Filtration Systems Inc. pp 534-579.

U.S. Environmental Protection Agency, 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document. p. 207.

U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. 1987. *A Compendium of Superfund Field Operations Methods*. EPA/540/p-87/001.



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MANUAL WATER LEVEL MEASUREMENTS

APPENDIX A
Example Field Data Sheet
SOP #2043
December 2002



Other significant observations:

STANDARD OPERATING PROCEDURES

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MANUAL WATER LEVEL MEASUREMENTS

		JURE 1. EXAMIT	LE FIELD D	ATA SHEET	
					PAGE_
TE NAME:				LOGGER NAM	E:
TE LOCATION: _				ERTC WAM: _	
OG DATE:				WBS #: <u>RIA</u>	
Well I.D. Ti	me Elevation of well ⁽¹⁾ (TOC)	Depth to bottom of well (feet)	Depth to water (feet)	Depth to product (feet)	COMMENTS (pH, temperature, specific conductance)
	casing (1) fee	et above mean sea le	1		

No. 2318.07A

Vapor Intrusion Port Installation and Sampling

May 3, 2013

Lorenzo P. Sena ENSV/CARB

APPROVED:

S/9/13

Peer Reviewer

Manager, CARB

Date

Date

Dinno Oroun

Independent QA Reviewer

Recertified:

Branch

Date

S/0/3017

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E.	CAUTIONS	Page 5 of 11
F.	INTERFERENCES	Page 5 of 11
G.	PERSONNEL QUALIFICATIONS	Page 5 of 11
Н.	EQUIPMENT AND SUPPLIES	Page 6 of 11
I.	PROCEDURAL STEPS	Page 7 of 11
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A. Purpose and Applicability

This method covers vapor intrusion sampling port installation and sampling procedures. This method covers the installation of these sampling ports in residential and commercial buildings. The ports described in these methods can only be installed in buildings with concrete floors which contact the ground, these include basements and slab on grade construction.

Vapor intrusion generally occurs when there is a migration of volatile chemicals from contaminated groundwater or soil into an overlying building. Volatile chemicals can emit vapors that may migrate through subsurface soils and into indoor air spaces of overlying buildings in ways similar to that of radon gas seeping into homes.

In extreme cases, the vapors may accumulate in dwellings or occupied buildings to levels that may pose near-term safety hazards (e.g., explosion), acute health effects, or aesthetic problems (e.g., odors). Typically, however, the chemical concentration levels are low or, depending on site-specific conditions, vapors may not be present at detectable concentrations. In buildings with low concentrations of volatile chemicals, the main concern is whether the chemicals may pose an unacceptable risk of chronic health effects due to long-term exposure to these low levels.

A complicating factor in evaluating the potential chronic risk from vapor intrusion is the potential presence of some of the same chemicals from emission sources in the building (e.g., household solvents, gasoline, cleaners) that may pose, separately or in combination with vapor intrusion, a significant human health risk.

Subslab air, unlike indoor/ambient air, is not affected by indoor sources of VOCs (e.g. household solvents, gasoline, cleaners). In theory, subslab samples should provide information on the actual amount of volatile organic compounds (VOCs) migrating from the contaminated groundwater to the surface immediately below the building which is being samples. While these subslab samples will not provide information on the actual amount of VOCs in the indoor air, they will provide information on the potential impact to indoor air from subsurface contamination.

B. <u>Summary of Method</u>

This method involves drilling stepped holes into concrete floors and the installation of pre-cleaned stainless steel subslab sampling ports (See Figure 1).

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C. Definitions

Subslab – This is the airspace that exists below the concrete slab of a building.

Footing – This is the concrete structure which provides support to a building's foundation walls and support pillars. Footings for residences range from 5" to 8" from the edge of the foundation walls. Footings for commercial buildings typically range from 12" to 18" from the edge of the foundation wall.

Vapor Intrusion – The migration of subslab vapors from a contamination plume into a building.

VOC Free Water – Water which has been sparged with Zero grade air or boiled for 20 minutes to remove Volatile Organic Compounds (VOCs).

Vapor Intrusion Port – A pre-cleaned stainless steel tubing and associated Swagelock connector used to sample Subslab air (See Figure 1.)

Hydraulic Cement – Is waterproof quick setting concrete mixture which resists shrinking and cracking and is used when grouting subslab ports.

Air Sampling Canister - A passivated or slinanized stainless steel canister which is cleaned and evacuated and is used to collect air (or subslab) samples.

D. Health and Safety

This procedure involves the use of a large rotary hammer. All personnel who will be performing drilling must have read the rotary hammer operation manual and be familiar with its operation.

This procedure also involves entering residences and commercial buildings. It is highly recommended for personal safety that at least two people perform this activity.

Drilling the concrete floor in the lowest area of a building typically involves working in damp or wet environments, care must be taken to reduce the chances of electrical shock by using a properly grounded outlet, rotary hammer and extension cord (preferably equipped with a Ground Fault Circuit Interrupter GFCI). In addition, extreme caution must be exercised when drilling near utilities or suspected utilities.

In addition to electrical hazards, biohazards are also quite common, these include spiders (Brown Recluse and Black Widow), snakes and leaking sewer lines

Safety glasses and hearing protection must be worn during all drilling operations.

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Dusts created when drilling concrete can contain various hazardous materials including cyrstaline silica, asbestos (from tile or mastic) and heavy metals. Care must be taken to ensure that all cutting is performed wet to minimize dust generation.

Gloves and safety glasses should be worn when working with hydraulic cement. The high pH causes saponification of skin oils and causes cracking and drying of the skin and immediately damages the eyes and mucous membranes.

In addition to the above mentioned health and safety cautions all personnel involved in sample collection and analyses must follow the Health and Safety Plan (HASP) for the associated activity.

E. Cautions

Most concrete is reinforced with rebar and can contain large aggregate, drilling through either of these two will cause the rotary hammer to twist unexpectedly.

F. <u>Interferences</u>

To ensure sample integrity a leak check must be performed each time a sample is collected. Grab samples should be collected at a rate no greater than 200 cc/min to minimize short circuiting. Nitrile gloves must be worn when fueling vehicles and hands must be washed prior to port installation and sample collection to reduce the chances of contamination.

VOC free water must be used for all operations in this procedure to reduce the possibility of sample contamination.

Sample ports must be pre-cleaned using Alconox or Liquinox solution then thoroughly rinsed with DI water to remove cutting and forming lubricants. The ports should then be rinsed with chromatography grade methanol and then baked at 100°C for at least 2 hours. Corks used for the installation of these ports must also be baked for at least 4 hours at the same temperature.

G. Personnel Qualifications

At a minimum, personnel must have taken the 24 hour field health and safety training. Per crew of two, at least one of the personnel must have had prior experience using a rotary hammer, installing and sampling subslab ports.

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H. <u>Equipment and Supplies</u>

Port Installation

Pre-cleaned stainless steel subslab ports (see Figure 1)

Hydraulic Cement

VOC free Water (for dust suppression and mixing with hydraulic cement)

Rotary hammer

1 3/4" carbide tipped rotary hammer bit

3/4" carbide tipped rotary hammer bit

1/2" conduit for removing cuttings and creating an air space below the port, also used to set the cork to its proper depth.

Hammer

Ziplock bags

1/4" NPT to 1/4" tube adapter (used to hold port during installation)

1/4" NPT flush fitting plug for capping finished port

Leak Check

Ultrapure Helium

Helium shroud

Teflon Tubing

Leak Detector

Evacuation Chamber

Vacuum Pump

Tedlar Bags

Flow Meter

Iospropyl Rubbing Alcohol

Paper towel

Sampling

Pre-cleaned 6L Stainless Steel Sampling Canisters

8 or 24 hour Flow Controller with Filter (for composite samples)

Tedlar Bag

Evacuation Chamber

Vacuum Pump

Flow Meter (for collecting grab samples)

Teflon Tubing

1/4" NPT fitting

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I. Procedure

Location:

Prior to beginning any drilling a visual survey of the building must be performed. Ideally a construction drawing showing utility locations can be reviewed and used to select drilling locations. The locations of utilities such as gas lines, sewer (storm and sanitary), power and water lines should be determined. Residential buildings require at least two ports and commercial buildings usually require at least one port per 5,000 square feet (unless the purpose of the activity is to screening the building for potential vapor intrusion). All ports should be installed in the lowest level of the building in which subslab soil contacts the concrete slab. Ports should be located centrally and should not be installed near exterior walls to minimize the sampling of outdoor air. Concrete in the area should be as crack free as possible to reduce short circuiting and minimize the sampling of indoor air.

Port Types:

Temporary Port – A temporary port is a pre-cleaned stainless steel port which is installed without grout. It instead uses a short piece of silicone tubing to form the seal. The hole is drilled, cleaned out, and allowed to equilibrate for 20 minutes prior to sampling. This port is meant to be removed immediately following sampling and the hole is patched with hydraulic cement.

Semi-Permanent – A pre-cleaned knurled stainless steel port which is set with hydraulic cement (see Figure 1) but does not have the 1/4" NPT to1/4" Swagelock union and is instead a 1/4" tube protruding above of the surface of the concrete about 1 inch and meant to be removed after one sampling event

Permanent- A pre-cleaned knurled stainless steel port designed to be installed and sampled over a long period of time, this port is sealed with grout and is mounted flush to the floor (see Figure 1) and is the most durable and resistant to leaks over a long period of time.

Installation:

Temporary Port: Drill a 3/8" hole in the concrete. Use a small squirt bottle to apply VOC free water while drilling to reduce dust. Clean hole using a clean bottle brush and a small amount of the VOC free water. Place the silicone tubing into the hole and hold the two tabs with your feet while pushing the stainless steel port into position with a1/4" Swagelock tee. Cap the port with a clean 1/4" vinyl plug for at least 20 minutes prior to sampling.

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Semi-Permanent: Drill a 3/4" hole through the concrete slab. Use a small squirt bottle to apply VOC free water while drilling to reduce dust. Clean the hole using a bottle brush and a small amount of the VOC free water. Hammer a clean piece of 1/2" electrical conduit to remove the water, remaining cuttings and create an air space below the port, remove the conduit and dump its contents into a waste container, rinse the conduit. Visually check the thickness of the concrete and set the depth of the cork (about 1/2" from the bottom of the hole in the concrete) with the conduit used to clean the hole. Push the port into the hole in the cork until the top of the port sits about 1" above the surface of the concrete. Add Hydraulic cement and water to a Ziplock bag to quickly create a mixture with the consistency of toothpaste. Tear a corner off of the bag and squeeze the contents into the hole until it is flush with the surface of the concrete. Wiggle the port to release any air bubbles and allow the hydraulic cement to flow into all the voids then re-fill the hole with concrete if needed to ensure the concrete is flush with the surface.

Permanent: Drill a 1 3/4" diameter hole approximately 1 3/4" deep. Use a squirt bottle to apply VOC free water while drilling to reduce dust. Drill a 3/4" hole in the center of the 1 3/4" hole which pierces the concrete. Clean the hole using a clean bottle brush and a small amount of the VOC free water. Hammer a clean piece of 1/2" electrical conduit to remove the water, remaining cuttings and create an air space below the port, remove the conduit and dump its contents into a waste container, rinse the conduit. Visually check the thickness of the concrete and set the depth of the cork (about 1/2" from the bottom of the hole in the concrete) with the conduit used to clean the hole. Push the port into the hole in the cork so the top surface is flush with the concrete surface. Add Hydraulic cement and water to a Ziplock bag to quickly create a mixture with the consistency of toothpaste. Tear a corner off of the bag and squeeze the contents into the hole until it is flush with the surface of the concrete. Wiggle the port to release any air bubbles and allow the hydraulic cement to flow into all the voids then re-fill the hole with concrete if needed to ensure it is flush with the surface.

Leak Check

After port installation and before any and all samples are collected from a port a leak check must be performed (except isopropyl leak check method which, is performed while the sample is being collected). Leak checks for temporary ports can be performed immediately after installation. Leak checks for ports installed using hydraulic cement can only be performed at least 24 hours after the port has been installed. A leak is defined as any significant reading above the background reading on a leak detector (for helium leak check), or any detection of isopropyl alcohol in the samples.

Helium is the most useful and practical way of determining the integrity of a port because, it is available, detectable and can penetrate even the smallest leaks.

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The simplest method for leak checking is to connect the tank of helium to the port and begin pushing helium into the port at 20 to 30 psi while checking all the seams and areas around the port with a leak detector (which has been pre-zeroed with room air). Even though this is the simplest method for leak checking it is only useful after the port is installed to verify the installation. After a port is leak checked using this method the port must not be sampled for at least two weeks. It must also be noted that this method consumes the most helium.

The most useful way of performing a leak check is by connecting a section of Teflon tubing to a port which runs through a shroud (See Figure 2). Another port is installed through the bucket and this is where the helium is connected. The tubing which connects to the port is connected to an evacuation chamber with an open 1L Tedlar bag. Prior to starting the helium flow a pre-helium Tedlar bag sample should be taken and used to zero the leak detector. Install a new 1L Tedlar bag in to the evacuation chamber and then start the helium flow at approximately 20psi. Wait at least 1 minute after starting the helium flow to allow the helium to fully displace the air in the shroud. Then collect a post helium sample in the Tedlar bag. Check the sample using the leak detector, any significant detection of helium in the sample is a leak and must be remedied prior to sampling this port. If the port passes the leak check, a sample can now be collected from the port. The leak check also serves to purge the port prior to sampling.

Leak checks can also be performed on a port using isopropyl alcohol (rubbing alcohol 70% from a drugstore is acceptable) or another suitable and detectable VOC which is not present at any detectable concentration in the subslab vapors. To leak check a port using this method the sample container must be connected to the sample port. Pour isopropyl alcohol (or other VOC) on a paper towel and wring out the excess then place the paper towel within 6 inches of the sampling port. If any isopropyl alcohol is present in the sample, then there was a leak in the port or sample tubing. The downside to this method is that one does not know that there is a leak until the sample results are read and then the sample must be repeated after the leak is fixed.

Sampling

All sample collection must be performed at a flow rate less than or equal to 200 cc/min this will ensure that the vacuum on the port is not high enough to draw air from indoor air and will allow a representative sample of subslab gas to be collected. All ports and tubing must be purged prior to sampling (the 2L of subslab air collected during the per-sampling leak check are sufficient).

Tedlar Bags

Samples collected in Tedlar[®] Bags should be collected using the methods described in EPA ERT SOP#2102 Tedlar[®] Bag Sampling. Samples colleted in

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Tedlar® bags must be analyzed within 24 hours otherwise, the data should be qualified. The samples should be kept in a dark place at ambient temperature until they are analyzed.

Stainless Steel Sampling Canisters

Air samples collected in air sampling canisters will be collected as either grab or composite samples using an evacuated canister collection system in accordance with EPA Region 7 SOP 2313.4, "Air Sampling With Stainless Steel Canisters". Composite samples of 8 or 24 hours are used depending on if the building is residential or commercial. Samples collected in residences are typically collected as 24 hour composite samples and samples collected in commercial buildings are typically collected as 8 hour composites.

Port Removal

The difficulty of port removal depends on the type of port installed. Temporary ports can be removed by pulling with a pair of pliers. Semi-Permanent ports can be removed by tapping the top of the port with a hammer and then pulling the port out with a pair of pliers. The removal of Permanent ports requires the use of the HET port remover. To remove a port using this method, screw the HET port remover into the port and then sharply hammer the top of the tool with the slide hammer.

Once a port has been removed, it can be filled with hydraulic cement and leveled off. Care should be taken to ensure that the hydraulic cement mix is not too runny otherwise the hydraulic cement patch will crack, ideally the mixture should be the consistency of toothpaste.

J. Data and Records Management

Field notes containing the address, port location, leak check results, observations made during sampling and sampling canister initial and final vacuum will be maintained in a field logbook or in the sample collection field sheets.

K. Quality Control

The leak check ensures that the port is sealed from the ambient air and that a representative sample of subslab vapors is being collected. To determine the variability of analysis a duplicate sample should be collected at a rate of at least 5%. This duplicate must be collected by connecting a tee fitting to the port and then connecting each side of the tee to a canister. Trip blanks must also be incorporated to ensure that exposure to the environment during sample collection has not affected the integrity of the sample, Trip blanks consist of an empty

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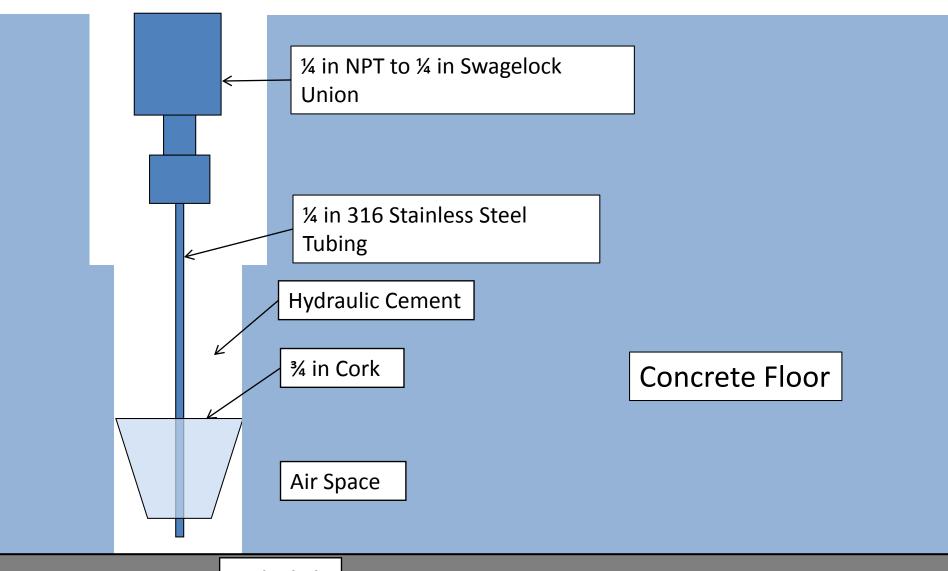
unopened sampling canister or a Tedlar bag containing ultrapure nitrogen. Trip blanks should be used at a rate of at least 5%.

L. References

- 1. U.S. EPA Region VII SOP #2313.4 Air Sampling With Stainless Steel Canisters.
- 2. U.S. EPA ERT SOP#2102 Tedlar Bag Sampling

Figure 1

Sampling Port Inlet Detail

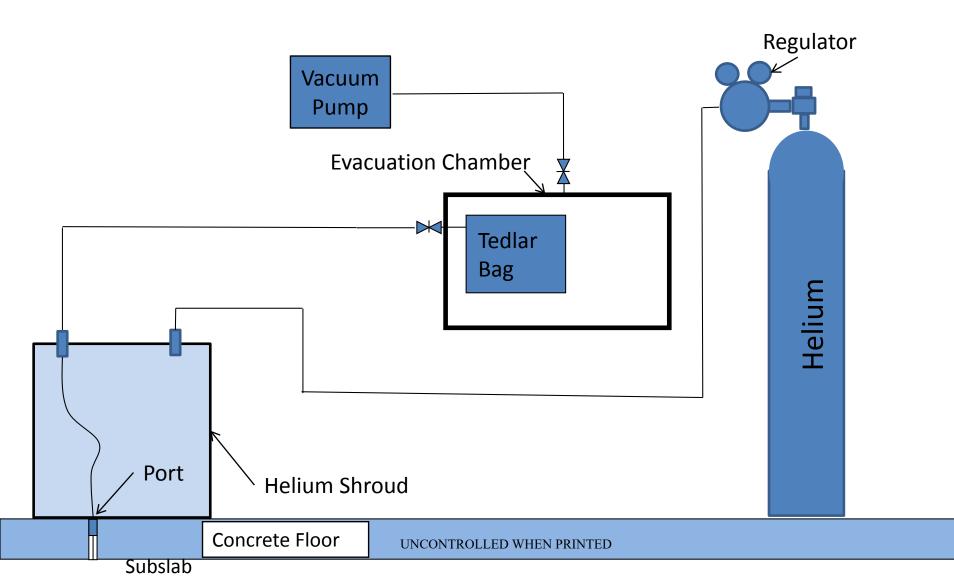


Subslab

UNCONTROLLED WHEN PRINTED

Figure 2

Subslab Grab Sampling and Leak Testing Apparatus



EPA Region 7 Laboratory Analysis Information

10/02/2018 08:35

Analysis Name: VOC's in Soil at Low Levels by GC/MS Closed-System Purge-and-Trap

Analysis Short Name VOA LDL S.16F Parameter Class: Volatiles

Matrix: Solid Analysis Status: Current

Analysis Summary:

This analysis is performed following RLAB Method 3230.16 and provides analytical data for 51 volatile organic compounds (VOC's) in a solid matrix. This method is based on SW846 methods 5035A and 8260C and satisfies all the applicable program requirements for both Superfund and RCRA.

The samples are collected in a pre-weighed 40 mL VOA vial to which preservative solution and a stirring bar have been added. A 5-gram aliquot of sample is added and the vial sealed, never to be opened until after analysis. The compounds are determined by purging the components from the sample with stirring and Helium into an gas chromatography column coupled with a mass spectrometer. Compound reporting limits are dependant on the amount of sample collected and the matrix, most compounds are reported at 5 ug/Kg.

Method: RLAB Method 3230.16F Date Adopted: 03/27/2018 Date Replaced:

Method Desc:

EPA Region 7 RLAB Method 3230.16F

Method Title:

GC/MS Analysis of Low Level Volatile Compounds in a Solid Matrix by Closed-System Purge-and-Trap

Method Summary:

VOC's are determined by collecting an approximately 5-gram sample, weighed in the field at the time of collection or approximated using a plastic syringe barrel, and placing it in a pre-weighed vial with a septum-sealed screw-cap that already contains a stirring bar and a sodium bisulfate preservative solution. The entire vial is then placed, unopened, into the instrument. Immediately before analysis, organic-free water, surrogates, and internal standards are automatically added without opening the vial. The vial is then heated and the volatiles are purged onto a trap with helium and stirring. The trap is then heated and the volatiles are flushed onto the GC column and are analyzed by GC/MS.

Base Method(s)	Title	Type
SW846 5035A	Closed-System Purge-and-Trap and Extraction for Volatile	Prep
	Organics in Soil and Waste Samples	
SW846 8260C	Volatile Organic Compounds by Gas Chromatography/Mass	Analysis
	Spectrometry (GC/MS)	

Capable Labs: EPA (In-House)

ESAT (In-House) CLP (Out-Source) REST (Out-Source) Analysis Name: VOC's in Soil at Low Levels by GC/MS Closed-System Purge-and-Trap

Previous Method: RLAB Method 3230.16E Date Adopted: 11/09/2010 Date Replaced: 03/27/2018

Sample Holding Time 14 **Days Extract Holding Time**: 0 **Days Weight Type**: Dry **Container Type**: 40mL VOA vials (soil **No Of Containers**: 4 **No Of Tags**: 2

VOA 5035)

Preservative: 4 Deg C, sodium bisulfate (2 vials), MeOH (1

vial)

Sampling Info:

SW846 Method 5035

Sampling Narative:

As with any sampling procedure for volatiles, care must be taken to minimize the disturbance of the sample in order to minimize the loss of volatile components. Several techniques may be used to transfer a sample to the relatively narrow opening of the low concentration soil vial. These include devices such as the EnCore sampler, the Purge-and-Trap Soil Sampler, Terra Core Sampler, and a cut plastic syringe. Sampling kits such as Environmental Sampling Supply part number 5035 KITA (or equivalent) contain the sampling device, sodium bisulfate-preserved vials, methanol-preserved vial, and empty bottle for percent solids.

Using the appropriate sample collection device, collect approximately 5 g of sample as soon as possible after the surface of the soil or other solid material has been exposed to the atmosphere. Add the sample to the sample vial containing the preservative (sodium bisulfate) solution. Quickly brush any soil off the vial threads and immediately seal the vial with the septum and screw-cap. Store samples on ice at 4 C. Collect at least two replicate samples. This will allow the laboratory an additional sample for reanalysis. The second sample should be taken from the same soil stratum or the same section of the solid waste being sampled, and within close proximity to the location from with the original sample was collected.

In addition, since the soil vial cannot be opened without compromising the integrity of the sample, one additional aliquot of sample must be collected and preserved with methanol for screening and high concentration analysis (if necessary). The methanol-preserved aliquot must be collected in a 40-mL vial that has been pre-weighed with 5 mL methanol in it. Quickly brush any soil off all vial threads and immediately seal the vial with the septum and screw-cap.

Finally, one additional aliquot of sample must be collected for percent solids determination. An empty plastic bottle is included in the 5035 KITA for this purpose.

ASR number and sample numbers are to be written on the existing labels on the pre-preserved vials; do NOT apply additional tags to these vials as their weight will bias the analytical results. The sampler must add sequential vial numbers to the lower corner of the pre-preserved vial tags starting with 4 (i.e. 4, 5, ...) for each sample. Vinyl tags provided by Region 7 should be used on the outer bundling and percent solids bottle. One sample per 20 needs to have two additional preserved aliquots for QC purposes.

Default Report Flag	Analyte Name	CAS Number	TRL	Units	RLAB Nelac Status		
Yes	Acetone	67-64-1	10	ug/kg	Certified	SW846 8260	
Con	Acrylonitrile	107-13-1		ug/kg			
Yes	Benzene	71-43-2	5	ug/kg	Certified	SW846 8260	

Analysis Name: VOC's in Soil at Low Levels by GC/MS Closed-System Purge-and-Trap

Default Report Flag	Analyte Name	CAS Number	TRL	Units	RLAB I	Nelac Status
Con	Bromochloromethane	74-97-5		ug/kg		
Yes	Bromodichloromethane	75-27-4	5	ug/kg	Certified	SW846 8260
Yes	Bromoform	75-25-2	5	ug/kg	Certified	SW846 8260
Yes	Bromomethane	74-83-9	5	ug/kg	Certified	SW846 8260
Yes	2-Butanone	78-93-3	10	ug/kg	Certified	SW846 8260
Yes	Carbon Disulfide	75-15-0	5	ug/kg	Certified	SW846 8260
Yes	Carbon Tetrachloride	56-23-5	5	ug/kg	Certified	SW846 8260
Yes	Chlorobenzene	108-90-7	5	ug/kg	Certified	SW846 8260
Yes	Chloroethane	75-00-3	5	ug/kg	Certified	SW846 8260
Yes	Chloroform	67-66-3	5	ug/kg	Certified	SW846 8260
Yes	Chloromethane	74-87-3	5	ug/kg	Certified	SW846 8260
Yes	Cyclohexane	110-82-7	5	ug/kg		
Yes	1,2-Dibromo-3-Chloropropane	96-12-8	5	ug/kg		
Yes	Dibromochloromethane	124-48-1	5	ug/kg	Certified	SW846 8260
Yes	1,2-Dibromoethane	106-93-4	5	ug/kg	Certified	SW846 8260
Yes	1,2-Dichlorobenzene	95-50-1	5	ug/kg	Certified	SW846 8260
Yes	1,3-Dichlorobenzene	541-73-1	5	ug/kg	Certified	SW846 8260
Yes	1,4-Dichlorobenzene	106-46-7	5	ug/kg	Certified	SW846 8260
Yes	Dichlorodifluoromethane	75-71-8	5	ug/kg	Certified	SW846 8260
Yes	1,1-Dichloroethane	75-34-3	5	ug/kg	Certified	SW846 8260
Yes	1,2-Dichloroethane	107-06-2	5	ug/kg	Certified	SW846 8260
Yes	1,1-Dichloroethene	75-35-4	5	ug/kg	Certified	SW846 8260
Yes	cis-1,2-Dichloroethene	156-59-2	5	ug/kg	Certified	SW846 8260
Yes	trans-1,2-Dichloroethene	156-60-5	5	ug/kg	Certified	SW846 8260
Yes	1,2-Dichloropropane	78-87-5	5	ug/kg	Certified	SW846 8260
Yes	cis-1,3-Dichloropropene	10061-01-5	5	ug/kg	Certified	SW846 8260
Yes	trans-1,3-Dichloropropene	10061-02-6	5	ug/kg	Certified	SW846 8260
Con	1,4-Dioxane	123-91-1		ug/kg		
Con	Ethyl Acetate	141-78-6		ug/kg		
Yes	Ethyl Benzene	100-41-4	5	ug/kg	Certified	SW846 8260
Yes	2-Hexanone	591-78-6	5	ug/kg	Certified	SW846 8260
Con	Isobutyl Alcohol	78-83-1		ug/kg		
Yes	Isopropylbenzene	98-82-8	5	ug/kg		
Yes	Methyl Acetate	79-20-9	5	ug/kg		
Yes	Methyl tert-butyl ether	1634-04-4	5	ug/kg		
Yes	Methylcyclohexane	108-87-2	5	ug/kg		
Yes	Methylene Chloride	75-09-2	5	ug/kg	Certified	SW846 8260
Yes	4-Methyl-2-Pentanone	108-10-1	5	ug/kg	Certified	SW846 8260
Yes	Naphthalene	91-20-3	10	ug/kg	Certified	SW846 8260
Con	2-Nitropropane	79-46-9		ug/kg		
Yes	Styrene	100-42-5	5	ug/kg	Certified	SW846 8260
Yes	1,1,2,2-Tetrachloroethane	79-34-5	5	ug/kg	Certified	SW846 8260
Yes	Tetrachloroethene	127-18-4	5	ug/kg	Certified	SW846 8260

Analysis Name: VOC's in Soil at Low Levels by GC/MS Closed-System Purge-and-Trap

Default Report Flag	Analyte Name	CAS Number	TRL	Units	RLAB I	Nelac Status
Yes	Toluene	108-88-3	5	ug/kg	Certified	SW846 8260
Yes	1,2,3-Trichlorobenzene	87-61-6	5	ug/kg		
Yes	1,2,4-Trichlorobenzene	120-82-1	5	ug/kg		
Yes	1,1,1-Trichloroethane	71-55-6	5	ug/kg	Certified	SW846 8260
Yes	1,1,2-Trichloroethane	79-00-5	5	ug/kg	Certified	SW846 8260
Yes	Trichloroethene	79-01-6	5	ug/kg	Certified	SW846 8260
Yes	Trichlorofluoromethane	75-69-4	5	ug/kg	Certified	SW846 8260
Yes	1,1,2-Trichlorotrifluoroethane	76-13-1	5	ug/kg		
Yes	Vinyl Chloride	75-01-4	5	ug/kg	Certified	SW846 8260
Yes	m and/or p-Xylene	179601-23-1	10	ug/kg	Certified	SW846 8260
Yes	o-Xylene	95-47-6	5	ug/kg	Certified	SW846 8260
Con	total Xylene	1330-20-7		ug/kg		
Surr	4-Bromofluorobenzene	460-00-4		% Rec		
Surr	1,2-Dichloroethane-D4	17060-07-0		% Rec		
Surr	Toluene-D8	2037-26-5		% Rec		

Default Report Flag: Con Analyte that is not reported from in-house analysis and must be obtained through an out-source contract lab.

Surr Surrogate compound for quality control purposes.

Yes Analyte that is routinely reported from in-house analysis.

RLAB NELAC Status applies specifically to analyses performed in the Region 7 Laboratory. Analyses done by out-source contract labs may not have this certification.

Appendix D

Example Documentation

Ogallala Surface Water Level Measurement Gravel Pit Lake

Date:_											
Time:											
Field I	spector:										
1.	Position survey level to allow measurement above well MW-11A.										
2.	Place Rod on top of PVC riser at well MW-11A. Use new glove on bottom of Rod to protect well.										
3.	Rod Reading at well MW-11A (to hundredths)ft										
4.	Place bottom of Rod at water surface.										
5.	Rod Reading with bottom of Rod at water surface (to hundredths)ft										
6.	Do twice.										
	Elevation TOC EPA 11-A <u>3208.03 ft MSL</u>										
	Rod Reading EPA 11-A +										
	Rod Reading Gravel Pit Lake Surface										
	Elevation Gravel Pit Lake =										

		Pro ID: DSA71301 Matrix: Water Cont: 40mL VOA vial #1 Pres: 4 Deg C, HCL to pH<2	2921-24- 1 VOA LDL W.13C	Pro ID: DSA71301 Matrix: Water Cont: 40mL VOA vial #2 Pres: 4 Deg C, HCL to pH<2	2921-24- 1 VOA LDL W.13C
		Start://		Start://	
Pro ID: DSA71301 Matrix: Water Cont: 40mL VOA vial #3 Pres: 4 Deg C, HCL to pH<2	2921-24- 1 VOA LDL W.13C	Pro ID: DSA71301 Matrix: Water Cont: 40mL VOA vial #4 Pres: 4 Deg C, HCL to pH<2	2921-24- 1 VOA LDL W.13C	Pro ID: DSA71301 Matrix: Water Cont: 40mL VOA vial #5 Pres: 4 Deg C, HCL to pH<2	2921-24- 1 VOA LDL W.13C
Start:/	:	Start:/		Start:/	
End: / /	:	End: / /	:	End: / /	

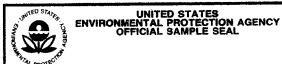
Sample Collection Field Sheet US EPA Region 7 Kansas City, KS

ASR Number:	2921 Sample Number:	24	QC Co	de: Mati	ix: Water Tag	ID: 2921-24					
Project ID:	DSA71301 Project Manager: DeAndre Singletary Railroad Avenue GW - Phase 2 sampling										
	Des Moines	13C Z 3	sampling	State	: Iowa						
_	RAILROAD AVENUE GROU SITE - NORTH PLUME	NDWA	TER CON	ITAMINATION	Site ID: A713	Site OU: 01					
Location Desc:											
	ı	xterr	nal Samp	ole Number:							
Expected Conc	(or Circle One:	Low	Medium	High)	Date	Time(24 hr)					
Latitude:		Sam	iple Coll	ection: Start:	//	:					
Longitude:				End:	//	*					
Laboratory An	alyses:										
Container	Preservative	Holdir	ng Time	Analysis							
4 - 40mL VOA vial	4 Deg C, HCL to pH<2	14	Days	1 VOCs in Water	r by GC/MS for Low D	etection Limits					
Sample Comme	ents:					A					
(N/A)											

Sample Collected By: GF

CHAIN OF CUSTODY RECORD ENVIRONMENTAL PROTECTION AGENCY REGION VII

ACTIVITY LEADER(F	Print)			NAME	OF SUR	VEY (OR ACTIVITY	Y				7	DATE OF COLLECTION SHEET
				<u> </u>									DAY MONTH YEAR OF
CONTENTS OF SHIP	MENT									M			
SAMPLE NUMBER	CUBITAINER	BOTTLE		F CONTAIN	NERS BOTTLE	Ē	VOA SET (2 VIALS EA)		T	sediment Dana		other	(condition of samples upon receipt
1101712		•			SAMPLE NUI			water	Soil	sedir	dust	<u></u>	other sample numbers, etc.)
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EPA FORM 7500-2(R7-75)



RECEIPT FOR SAMPLES

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SAMPLERS: (Signature)	(Signatur	e)					I				
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Date						Time		Title Date		Time	
	ä										

Distribution: White copy retained by sampler: Yellow copy to sample recipient

0368235436



City

* To mest locations. Packages over 150 lbs. FedEx 3Day Freight Third business day.** Seturday Delivery NOT avadable ** To most locations. Other red value limit \$500. Cash/Check Total Packages Total Weight Total Declared Value 12e \$ Our listbiliny is limited to \$100 unless you declare a higher vakus. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our lisbility. Residential Delivery Signature Options If you require a signature, check Direct or Indirect No Signature Required Package may be left without obtaining a signature for delivery. Direct Signature Indirect Signature
If no one is available at
recipient's address, someone
at a neighboring address may
sign for delivery. Fee applies. Someone at recipient's address may sign for delivery. Fan applies. 519